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ABSTRACT

This annotated bibliography presents summaries of 81 reports on personnel and training research conducted by the Air Force Human Resources Laboratory (AFHRL). Topics addressed include electronics, aeronautics, computers, mathematics, and operational research, as they relate to the selection, motivation, training, retention, education, utilization, and career development of military personnel. Reports are indexed by personal author, civilian corporate author, project type, title, and military research division. A keyword index is also provided. (MER)

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AIR FORCE HUMAN RESOURCES LABORATORY

ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS — 1979

By

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May 1981

Final Report

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AIR FORCE SYSTEMS COMMAND
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This bibliography was submitted by Technical Services Division, under Project 9981, with HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235.

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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Technical Services Division

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ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS — 1979

INTRODUCTION

The Air Force Human Resources Laboratory (AFHRL), Brooks AFB, Texas, was established in 1968 as an Air Force Systems Command (AFSC) laboratory. (During the early part of 1968, it was part of the Aerospace Medical Division.)

This Laboratory is charged with the planning and execution of Air Force exploratory and advanced development programs for selection, motivation, training, retention, education, assignment, utilization, and career development of military personnel; also the composition of the personnel force and training equipment. This Laboratory also provides technical and management assistance to support studies, analyses, development planning activities, acquisition, test evaluation, modification, and operation of aerospace systems and related equipment.

At the end of 1979, AFHRL consisted of a headquarters and two divisions at Brooks AFB and two geographically dispersed divisions as follows:

1. Manpower and Personnel Division, and Technical Services Division, Brooks AFB, Texas.

2. Logistics and Technical Training Division, Wright-Patterson AFB, Ohio.
   a. Logistics Research Branch, Wright-Patterson AFB, Ohio.
   b. Technical Training Branch, Lowry AFB, Colorado.

3. Operations Training Division, Williams AFB, Arizona.

Abstract entries list the division name at the time of report publication.

The abstracts appear in technical report number sequence. Entries following the author and title heading give information identifying the report and indicate where it is available.

Project number: Research areas identified by these numbers are given in the PROJECT index. The Air Force contract number and the name of the contracting organization are entered for contract-produced reports.

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This bibliography contains six indexes: PERSONAL AUTHOR, CIVILIAN CORPORATE AUTHOR, PROJECT, TITLE, DIVISION, and KEYWORD. Reports are identified in the indexes by the serial number appearing in the left margin of the abstract entries. This report does not contain classified or For Official Use Only technical reports.

1 **Barlow, E.M. Annotated bibliography of the Air Force Human Resources Laboratory technical reports — 1977. AFHRL-TR-79-1, AD-A068 143. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, February 1979. (Covers all AFHRL projects.) NTIS.** This annotated bibliography presents a listing of technical reports (1977) dealing with personnel and training research conducted by the Air Force Human Resources Laboratory (AFHRL).

The research has been conducted by professional personnel representing a variety of disciplines, including psychologists, operations research specialists, mathematicians, computer analysts, economists, electronic engineers, aeronautical engineers, and technical support personnel.

AFHRL is charged with the planning and execution of USAF exploratory and advanced development programs for selection, motivation, training, retention, education, assignment, utilization, and career development of military personnel; also the composition of the personnel force and training equipment. This Laboratory also provides technical and management assistance to support studies, analyses, development planning activities, acquisition, test evaluation, modification, and operation of aerospace systems and related equipment. (56 pages)

2 **Stenger, T., Dungan, W., & Reynolds, R. Computer image generation texture study. AFHRL-TR-79-2, AD-A074 019. Wright-Patterson AFB, OH: Advanced Systems Division, August 1979. Project 6114, Contract F33615-77-C-0063, Technology Service Corporation. NTIS.** This developmental project resulted from the need to enhance visual flight simulators (based on computer image generation (CIG) techniques) with textured surfaces. Pilots viewing homogeneous surfaces experience an inadequate perception of motion above these surfaces as well as an ambiguity in the orientation of the surface. Therefore, it was felt that by using textured surfaces within the scene, both depth and motion cues would be made available. This report describes the approaches and techniques used to develop texture material and introduce it into a complex CIG scene.

The approach is to create texture tile arrays of trees and grass from digitized photographs of natural texture. These arrays are then replicated over the surface in the fashion of tiles. Preprocessing techniques are described which eliminate the periodic effect due to the tile boundary and macropatterns within the tile itself. Level-of-detail texture tile arrays are created that match the resolution of the texture to the appropriate observer-scene viewing geometry.

The level-of-detail arrays and other descriptive parameters are merged into the existing CIG software to produce textured images. Scenes depicting a landing sequence, a divebomb, and a low-altitude flight were then generated. These images show the effect of the varying levels of detail, fields of view, viewing geometries, and scene contents on the textured scene. The texture tile technique and subsequent image generation show the feasibility of deriving distance and motion cues from the additional information contained in the textured images. (72 pages)

3 **Kelly, M.J., Wooldridge, L., Hennessy, R.T., Vreuls, D., Barnebey, S.F., Cotton, J.C., & Reed, J.C. Air combat maneuvering performance measurement. AFHRL-TR-79-3, AD-A077 429. Williams AFB, AZ: Flying Training Division, September 1979. Project 1123, Contract**

F33615-77-C-0079, Canyon Research Group, Incorporated. NTIS. A study was conducted to define measures of Air Combat Maneuvering (ACM) for one-versus-one (lvl) free engagements on the Simulator for Air-to-Air Combat (SAAC). The study found a small set of measures which were (a) sensitive to differences in pilot ACM skill level, (b) diagnostic of performance proficiencies and deficiencies, (c) usable by instructor pilots and compatible with their judgments, (d) capable of providing results immediately after the end of the engagement, and (e) compatible with current projected training and measurement hardware.

The study was conducted in three phases: Phase 1 was an analytical study of ACM tasks using information from training material and instructor pilots; 28 measures reflected subject matter experts opinion on the important elements of ACM. Pilot control, aircraft performance and engagement outcome variables were measured in Phase 2 during 405 free engagements on the SAAC at Luke AFB using a total of 30 pilots with three different levels of experience. A computer analysis of the engagement data was conducted in Phase 3 to (a) check methodological assumptions that the three pilot experience levels represented different ACM skill levels and (b) develop the smallest comprehensive measure set.

Out of the original 28 measures, 13 were found to discriminate between high and low skilled pilots. These measures, when properly weighted, could be added together to form a single metric of ACM performance which accounted for 51% of the variance in the free engagement performance data and predicted membership in high or low skill groups with 92% accuracy. A method to further improve the measurement model accuracy was suggested. As a consequence of these results, further development of diagnostic measurement, cross-validation of these results, further development of diagnostic measurement, cross-validation of the study results, and implementation of the measurement model for developmental testing and ultimate training use on the SAAC were recommended. (142 pages)

4 **Titsworth, W.L. Differences between crosstrainees and non-crosstrainees on grade level, job satisfaction, and assignment characteristics. AFHRL-TR-79-4, AD-A069 587. Brooks AFB, TX: Occupation and Manpower Research Division, May 1979. Project 7734. NTIS.** This study is an effort to identify the effects of crosstraining which might have implications for improving the management of Air Force personnel. Data on 7,986 crosstrainees and 15,083 non-crosstrainees working in 35 different Air Force specialties were analyzed to detect differences between these groups with regard to seven criteria. Subjects were enlisted personnel with from 4 to 20 years of service who responded to Air Force job surveys during the period 1967 through 1974. Multiple regression analyses were used which controlled for possible curvilinear relationships between the criteria and length-of-service. In 198 (81%) of 245 criterion-by-specialty analyses, the regression curves appropriate for crosstrainees and non-crosstrainees were not significantly different at the .01 level. In 31 analyses where the groups differed significantly with regard to either grade, number of tasks performed, job difficulty, or number of subordinates, the non-crosstrainee group predominately had higher expected values. With regard to the 16 significant differences on job satisfaction criteria (reenlistment intent, job interest, and felt utilization of talents and training), no consistent pattern favoring either crosstrainees or non-crosstrainees was observed. Implications of the results are discussed. (26 pages)

5 **DeLeo, P.J., & Slaughter, S.L. Measuring student attitudes toward the Air Force Traffic Safety Course. AFHRL-TR-79-5, AD-A071 408. Lowry AFB, CO: Technical Training Division, May 1979. Project USAS. NTIS.** A questionnaire survey was developed to measure the attitudes of

students toward the Air Force Traffic Safety Course. Mandatory for virtually all personnel entering the Air Force, this course was being taught in a standardized multimedia format at more than 140 locations throughout the world. It was a 10 hour course of instruction covering environmental hazards, vehicle control, emergency situations, etc. Dimensions measured by the questionnaire included attitudes toward instructor, course, and media effectiveness and opinions about various environmental features such as noise and temperature. Attitudes were measured both at unit level and to the course as a whole. Reliability was found to be acceptable. Results of a validation study are presented. It was recommended that the questionnaire be adopted for use and suggestions were made for data analysis procedures. (28 pages)

6 **Kottenstette, J.P. Microfiche applications in an individualized, self-paced learning system. AFHRL-TR-79-6, AD-A069 445. Lowry AFB, CO: Technical Training Division, May 1979. Project 1121, Contract F33615-77-C-0057, University of Denver. NTIS.** The microfiche medium offers proven advantages in the management, storage, and retrieval of information, as well as significant cost advantages. The study was directed towards developing microfiche formatting concepts and microfiche production methods to capture the power of the medium for delivery of both text and illustrations within context of the Advanced Instructional System (AIS)—a computer based, multi-media, self-paced instructional program of the Air Training Command at Lowry AFB, Colorado. Specific applications were (a) the conversion of color intensive audiovisual modules to microfiche; (b) the formatting of the microfiche to deliver both primary and alternative track modules in an integrated "multi-track" module, and (c) the use of microfiche in testing and test control. A primary consideration was the investigation of computer output microfiche (COM) technology as a means of authoring, revising, and managing instructional materials. A microfiche system was designed, utilizing existing AIS computer resources, which satisfied adminstrative as well as instructional requirements. The system is called the dual-fiche concept and provides a way to separate the production of the text component of an instructional module from the production of the graphics component, combining the two types of information at the point of use—the microfiche reader. This development brings the power of COM to bear directly on the problems of updating and revising instructional materials while gaining the flexibility necessary to produce graphics (particularly color-intensive graphics) consistent with content formatting requirements. The concept involves two transparencies (one with text and the other with graphics) which are projected simultaneously.

Applications were then developed in which specific AIS lessons were formatted for multi-track, color intensive presentation on microfiche. In addition, block tests were produced also using COM production techniques. Classroom trials were conducted and the microfiche systems were evaluated.

The Dual-Fiche concept charts a path that promises to be a cost-effective alternative to existing AIS instructional media and promises the additional benefit of routine update and revision of instructional modules that combine text and graphics. (48 pages)

7 **Pierce, B.J., De Maio, J., Eddowes, E.E., & Yates, D. Airborne performance measurement methodology application and validation: F-4 pop-up training evaluation. AFHRL-TR-79-7, AD-A072 611. Williams AFB, AZ: Flying Training Division, June 1979. Project 1123. NTIS.** A methodology was developed to evaluate pilot performance on the pop-up weapon delivery. Instructor pilot ratings were used to measure performance on the critical stages of the maneuver. Validity of the methodology was assessed using 21 pilots assigned to an F-4 training squadron. Results indicate that instructor pilot ratings of individual stages of the delivery yield a reliable index of the quality of performance on the maneuver. The individual stage performance ratings identified

the proficiency levels attained on certain flying skill areas critical to mission readiness. This information enabled an examination of the relationship between pilot learning and training program design. (20 pages)

8 **Thomson, D.C., & Goody, K. Three sets of task factor benchmark scales for training priority analysis. AFHRL-TR-79-8, AD-A072 465. Brooks AFB, TX: Occupation and Manpower Research Division, May 1979. Project 7734. NTIS.** The Occupation and Manpower Research Division of the Air Force Human Resources Laboratory has established that task training priority is a function of task factors and that, within a specialty, training priority ratings can be duplicated mathematically from task factor ratings. Because these ratings are measured on a different scale for each specialty, this methodology cannot be generally established and applied. To overcome this limitation, a series of benchmark scales was developed for the measurement of task factors against common frames of reference. This report presents the development of the benchmark scales for specialties with an electronic and a mechanical aptitude requirement. It then reports on the validation of the three sets of benchmark scales (Administrative/General, Electronic, and Mechanical). The benchmark scales were shown to have advantages and disadvantages compared with the traditional relative scales. (46 pages)

9 **Lammlein, S.E., & Borman, W.C. Peer rating research: Annotated bibliography. AFHRL-TR-79-9, AD-A071 409. Brooks AFB, TX: Personnel Research Division, June 1979. Project 7719, Contract F33615-78-C-0041, Personnel Decisions Research Institute. NTIS.** This report is an annotated bibliography of peer rating research. Personnel, industrial, and social psychology journals and technical reports were reviewed to identify studies employing peer ratings, and annotations of these studies were prepared. In our view, the most noteworthy findings from this literature are the following:

1. Peer ratings on personality traits consistently yield similar factor structures, suggesting that the dimensionality of these ratings may reflect raters' commonly held beliefs about personality.

2. Peer ratings typically show high interrater agreement, especially when the stability of these ratings is enhanced by gathering evaluations from many peers.

3. Peer ratings often correlate only moderately with ratings from other sources (e.g., supervisors). Presumably, such disagreements in ratings arise because members of different organizational levels have different perspectives on what it takes to perform effectively, and these groups typically view different samples of ratees' performance-related behavior.

4. Peer ratings often provide good predictions of subsequent performance in training or on jobs. This result has been most consistently obtained in military settings, but peer ratings in industry have also proven to be good indicators of future performance. Such successes have been attributed to peers' comparatively good opportunity to observe ratee behavior relevant to assessing performance effectiveness. (46 pages)

10 **Hendrix, W.H., & Halverson, V.B. Situational factor identification in Air Force organizations. AFHRL-TR-79-10, AD-A068 823. Brooks AFB, TX: Occupation and Manpower Research Division, May 1979. Project 2313. NTIS.** Research discussed in this report focused on factor analyzing the Job Inventory of the Organizational Assessment Package (OAP) to isolate the factors associated with a manager's situational environment. Nine factors were extracted and orthogonally rotated to simple structure. Each factor's internal consistency index was computed. The utility of the Job Inventory as an organizational diagnostic instrument is discussed. (20 pages)

11 **Mullins, C.J., Earles, J.A., & Wilbourn, J.M. Personnel rating effectiveness as a function of number of rating statements. AFHRL-TR-79-11, AD-A069 436. Brooks AFB, TX: Personnel Research Division, May 1979. Project 2313. NTIS.** Previous work on sets of personnel rating statements leave unanswered the question of whether there is any advantage in using several "factor" rating statements over the use of a single statement. This is a study of the comparative utility of sets of rating statements varying in number of statements per set, using an external criterion.

A great deal of research effort has been expended in an effort to find "best" factors for collecting rating data. Most of this research has concentrated on internal psychometric characteristics of the rating data, such as means, standard deviations, and reliability coefficients. When internal psychometric considerations constitute the sole criterion, some small advantage is frequently found for one kind of rating statements over another. When external criteria for evaluating "goodness" of rating sets are applied, there are usually no differences found among sets. Indeed, there have been some indications that raters generally may not be able to evaluate ratees on more than one general quality of overall excellence and that collecting several "factor" ratings may be little more than time wasted.

The subjects for this study were 132 students at the NCO academy at Lackland AFB. Three treatment conditions were applied. Of the 132 subjects, 45 were required to rate their peers in their 15-man study groups on 20 rating factors. Another 44 subjects rated their peers on 10 factors, which were a subset of the 20 factors used by the first group. Still another 43 subjects rated their peers on a subset of only five rating factors. From the ratings, profiles were developed for each subject indicating how that individual had been rated by a peer group. These profiles, with no identifying information on them, were handed out to the group members, who were required to identify them. A record was kept of all correct identifications. Analyses of variance were done to see if there were any significant differences among the three groups. In addition, correlation coefficients were computed between the various sets of rating statements and a criterion of class standing upon graduation, to see whether 20 statements predicted this criterion better than 10 and whether 10 statements were more predictive than five.

The analysis of variance portion of the study produced no significant differences among the groups. The multiple linear regression analyses indicated that, when only two of the statements were used as predictors, addition of the other 18 to the predictor pool generated no useful additional prediction. The results of this study indicate that a very small set of rating factors (e.g., two in this study) produce information about a ratee which cannot be improved by the addition of many more factor statements. (18 pages)

12 **Montgomery, A.D., & Judd, W.A. Computer-assisted instruction in the context of the advanced instructional system: Authoring support software. AFHRL-TR-79-12, AD-A081 071. Lowry AFB, CO: Technical Training Division, December 1979. Project 1121, Contract F33615-78-C-0022, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** This report details the design, development and implementation of computer software to support the cost-effective production of Computer-Assisted Instruction (CAI) within the context of the Advanced Instructional System (AIS) located at Lowry AFB. This report supplements the computer managed Air Force technical training that is currently supported by AIS, giving the Air Force a full function Computer Based Instructional system. The interactive Authoring Editor, Presentation Program, Data Collection, and Data Print software components of the CAI system are detailed. The Editor simplifies the authoring task by (a) eliminating the need for the author to use a computer language, (b) structuring the task, (c) providing computer aided input, and (d) extensive formatting and editing capabilities. The software also provides conditional and unconditional branching that can be specified from the Editor. (86 pages)

13 **Cicchinelli, L.F. Avionics maintenance training: Relative effectiveness of 6883 simulator and actual equipment—test and evaluation plan. AFHRL-TR-79-13, AD-077 342. Lowry AFB, CO: Technical Training Division, October 1979. Project 2361, Contract F33615-78-C-0018, University of Denver. NTIS.** Currently there are insufficient empirical data to assist informed decision-making regarding the conditions of simulator effectiveness in test station maintenance training. The purpose of this interim report is to document the implementation of a detailed test and cost-evaluation plan currently employed in the 326X training field. The objectives of this plan are to obtain quantitative and qualitative data for comparatively evaluating simulator and actual test equipment on dimensions of (a) instructional effectiveness (b) time-savings (c) life cycle cost elements (d) attitudinal acceptance and (e) subsequent field performance. Cost-benefit scenarios involving variation in parameter values, e.g., student flow, aptitude levels, course length and specific life cycle cost element data will permit analysts to make more objective determinations concerning the effectiveness and efficiency of simulators compared to actual equipment given different situations. (66 pages)

14 **Dobrovolny, J.L., McCombs, B.L., & Judd, W.A. Orientation/time management skill training lesson: Development and evaluation. AFHRL-TR-79-14, AD-A074 020. Lowry AFB, CO: Technical Training Division, July 1979. Project 1121, Contract MDA-903-77-0144, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** Materials contained within this report are designed to assist students in their adaptation to the novelties of a computer-assisted or -managed instructional environment. This Orientation/Time Management lesson provides students with appropriate role models for increasing acceptance of their increased responsibility for learning and, it introduces a progress tracking approach to assist students in achieving completion goals in a self-paced training environment. Evaluation data from an implementation of these materials in the Air Force Advanced Instructional System (AIS) suggest that substantial time savings can be obtained by a combination of this type of orientation and time management skill training with a computer-based progress targeting and feedback system (on the order of 9 to 18 percent reduction in course completion times). (116 pages)

15 **Moore, S.B., Madison, W.G., Sepp, G.D., Stracener, J.T., & Coward, R.E. Air combat training: Good stick index validation. AFHRL-TR-79-15, AD-A071 033. Williams AFB, AZ: Flying Training Division, June 1979. Project 1123, Contract F34601-77-A-0176, Vought Corporation. NTIS.** The Good Stick Index validation study statistically investigated an empirically derived measure of pilot proficiency in an air combat simulator. Statistical methods, including regression and discriminant analyses, were used to evaluate GSI scores as predictors of student free-engagement performances in the TAC ACES I simulator training program. Statistically derived performance predictors are obtained from objectively measured parameters recorded during simulator training. The effect of inclusion of student pilot demographic data with the objective data is investigated. Edumetric and psychometric data are presented as indicators of skill development.

Results of the study yield performance predictors for four groupings within each TAC ACES I class: (a) winners, (b) winners or runners-up, (c) upper-half winners, and (d) student quartile ranking. The empirically derived measure shows a probability of winner prediction of 25 percent, whereas the statistically derived optimal measure shows a probability of winner prediction of 80 percent. The reliability of the performance predictors is assessed. Potential utilization and limitations of the Good Stick Index are addressed. (158 pages)

16 **McFarlane, T., Kantor, J.E., & Guinn, N. Correlates of successful on-the-job performance in the Security Police (Air Force Specialty Code 81XXX) career field. AFHRL-TR-79-16, AD-A072 467. Brooks AFB, TX: Personnel Research Division, June 1979. Project 7719. NTIS.** A Security Test Battery, tapping pre-training biographic/demographic factors and post-training job experience factors, was administered in the field to 3,175 Security Police (81XXX) personnel. Job performance ratings were simultaneously collected on these personnel from their first-line supervisors. Using multiple linear regression analyses, it was found that 24 pre-training factors were significantly related to job performance. It was possible to categorize these specific items into four major areas: age, attitudes toward parents and former teachers, family's socio-economic status, and aspects of the individual's personal lifestyle. From the post-training job experience factors, 13 significant correlates of job performance were found which could also be grouped into four attitudinal areas: toward supervisors, the Air Force in general, environmental factors, and co-workers. Cross-application of these results indicated reasonable generalizability. The potential effects of manipulating these variables through selection, classification, and management are discussed. (32 pages)

17 **Woodruff, R.R. Effects of varying visual display characteristics of the T-4G, a T-37 flight simulator. AFHRL-TR-79-17, AD-A071 410. Williams AFB, AZ: Flying Training Division, June 1979. Project 1123. NTIS.** Two experiments were conducted using the T-4G, a T-37 flight simulator, to investigate the benefit to simulation of visual displays which have color or are collimated. Thirty-two Air Force undergraduate pilots learned approach and landing in the T-4G using either black and white or colored imagery. Thirty-eight instructor pilots performed approach and landing with visual displays that had collimation or reduced collimation. No statistically significant differences were found in either experiment. Power analysis shows that each of these experiments would have detected a practically significant difference, if one existed, with a probability of more than .75. There are no psychophysical reasons to use either color or collimation. User acceptance is another thing, and if color and collimation improve acceptance, they should be used. (18 pages)

18 **Seevers, J.A., & Makinney, R.L. Simulator for air-to-air combat motion system investigation. AFHRL-TR-79-18, AD-A072 612. Williams AFB, AZ: Flying Training Division, July 1979. Project 1123. NTIS.** This investigation was conducted to evaluate the Simulator for Air-to-Air Combat (SAAC) motion system response to known input signals, to observe platform movements, to measure leg extension velocities and accelerations, and to establish delay lags through the system electronics and hydraulics. Signal voltages at pre-established levels were input by a signal generator at the analog-to-digital converter simulating pilot's control stick movements. Resulting platform movement was recorded on strip chart recorder measuring accelerations and final positioning from six linear and angular accelerometers mounted beneath the motion platform. Several noticeable factors were revealed that contribute to the status of the motion platform being less than representative of motion of the aircraft. First, the motion platform lags the input command by a noticeable amount. The platform's motion is about a multiple set of axes rather than a single axis as the command would direct. Also, because of physical constraints on the size of the system, the magnitude and deviation of the motion are limited. A fourth major problem is that when the excursion is near the maximum allowable, the motion is stopped too abruptly, and this stopping is readily perceived by the pilot (the washout problem). (22 pages)

19 **Condon, C.F.M., Ames, L.L., Hennessy, J.R., Shriver, E.L., & Seeman, R.E. Flight simulator maintenance training: Potential use of state-of-the-art simulation techniques. AFHRL-TR-79-19, AD-A072 478. Lowry AFB, CO: Technical Training Division, June 1979. Project 2361,**

Contract F33615-77-C-0058, Kinton, Incorporated. NTIS. A study was undertaken to evaluate the potential application of state-of-the-art simulation technology to the area of maintenance training. The vehicle of the study was the 341XX career field, which is concerned with the maintenance of digital flight simulators. An analysis was performed on the types of maintenance tasks, especially troubleshooting tasks, performed by technicians in the field. An analysis was also done on the technical school training for this career field. Two technical school courses were the focus of study: Digital Flight Simulator Specialty (341X4) and Digital Navigation/Tactics Training Devices Specialty (341X6). The results of the task analysis and training analysis were used in a study to determine the types of simulation training approaches that would be most suitable for supporting the assessed training needs. Three training concepts were developed to support the types of maintenance skills and knowledges required in the 341XX career field. Air Force personnel then selected two of these training concepts for translation into prime item development specifications. (56 pages)

20 **McCombs, B.L., Dobrovolny, J.L., & Judd, W.A. Computer-managed instruction: Development and evaluation of student skill modules to reduce training time. AFHRL-TR-79-20, AD-A074 021. Lowry AFB, CO: Technical Training Division, August 1979. Project 1121, Contract MDA-903-77-0144, McDonnell Douglas Astronautics Company—St Louis. NTIS.** The development and evaluation of the CMI Student Skills Project are described within the context of the Air Force Advanced Instructional System (AIS). The student skill modules developed were designed as short packages to be assigned near the beginning of any military technical training course, but which included strategies or procedures that would continue to effect student behavior throughout the course (e.g., behavioral self control techniques). Following a series of student interviews to determine the characteristic problems students encounter in a CMI system, an Orientation to CMI/Time Management Lesson and Study Skills Package were developed and implemented. The Study Skills Package included a self-rating Student Study Skills Questionnaire and four study skills training modules in the areas of reading comprehension, memorization, test taking, and concentration management skills. An Instructor Orientation and Training Package was also developed to be used in conjunction with the study skills diagnostic and remedial materials, and to provide instructors with basic skills in their new role as facilitator of student learning. Evaluation results indicated that (a) substantial time savings can be obtained by a combination of CMI orientation and time management skill training with a computer-based progress targeting and feedback system (i.e., on the order of nine to 18 percent reductions in course completion times); (b) consistent student training time reductions and performance gains can be obtained by the use of the study skills materials for students identified as deficient in particular study skills areas; (c) the Study Skills Questionnaire was a reliable and valid measure of student skills in the four study skills areas and reliably discriminated students performing satisfactorily versus poorly in the AIS technical training environment; and (d) the Instructor Orientation and Training contributed to the efficient remediation of student study skill deficiencies and improved instructor perceptions of their CMI role. The results of this project are separately described in two sections of this report: an Executive Report Section and a Scientific Data Section. (134 pages)

21 **Hooke, L.R., DeLeo, P.J., & Slaughter, S.L. Readability of Air Force publications: A criterion referenced evaluation. AFHRL-TR-79-21, AD-A075 237. Lowry AFB, CO: Technical Training Division, September 1979. Project 1121. NTIS.** The major objective of this study was to investigate the readability of a sample of Air Force regulations which had been rewritten in accordance with a recent Air Force directive. Regulation writers are directed to match in their texts the target reading grade level (RGL) of the personnel who will use the regulations. The directive also specifies the method for estimating RGLs. In the first part of this study, the writer—estimated RGL for each regulation was rechecked by Air Force Human Resources Laboratory staff using the

FORCAST formula. It was found that four of the seven writers underestimated the RGL of their regulation by more than one grade level. None of the writers was able to produce a document with an RGL, as estimated by AFHRL, much below 11th grade, while the audience RGL of three of the seven fields was below 10th grade. The main portion of the study involved testing the comprehensibility of each regulation to its user audience by means of the CLOZE procedure. In this testing method, every fifth word of a passage taken from the regulation was deleted, and personnel were asked to fill in the blanks with their best estimates of the missing words. A criterion of a CLOZE score (40%) corresponding to a 75% score on a traditional comprehension test was set as the standard for adequate comprehension. Mean scores in three fields were clearly above criterion, and the score in one additional field was borderline. Using the term literacy gap to refer to a situation where a text is written at an RGL too high for its intended readers, it was found that in all cases when there was no such gap, comprehension was adequate. In all these cases, however, audience RGL was also quite high. In three of the four instances where a literacy gap did exist, comprehension scores were below criterion. In all three of these cases, RGL was low (below 9.2). (36 pages)

22 **Kniffin, J.D., Stevenson, C.R., Klare, G.R., Entin, E.B., Slaughter, S.L., & Hooke, L. Operational consequences of literacy gap. AFHRL-TR-79-22, AD-A084 782. Lowry AFB, CO: Technical Training Division, May 1980. Project 1121, Contract F33615-77-C-0048, Westinghouse Electric Corporation. NTIS.** Air Force managers and supervisors often face problems caused by reading difficulties among their personnel. These usually appear to be a joint function of level of reading skill of the personnel and level of difficulty of the materials they face. The term "literacy gap" refers to the difference between the two levels. This study proposed to examine the effects upon reading comprehension and preferences of three sizes of literacy gaps. This study involved three independent variables: Air Force personnel at tested reading grade levels (RGLs) of 8 and 10; Air Force job related materials, written at literacy gaps of 0, -2, and -4, and reading times of 30, 45, and 60 minutes. A gap of -2, for example, meant that the materials were two grade levels higher than the tested reading ability of the subjects. An additional question of interest was whether increasing the time allocated for reading would mitigate the effect of large literacy gaps. Thus, reading times of 30, 45, and 60 minutes were examined. Subjects were Air Force personnel at two levels of reading ability, 8th and 10th grades. Content was chosen from Air Force job-related material in two areas: Supervision and Safety/Sanitation. Reading materials consisted of 5250 word passages prepared at readability grade levels of 8, 10, 12, and 14, with content unchanged. Multiple choice tests of comprehension were also prepared and a short questionnaire designed to measure preferences was developed.

Preference measures indicated that readers judged lower-gap materials significantly easier to read and clearer than higher gap materials. When comprehension scores were analyzed, the results were as follows: (a) performance on the Safety/Sanitation passage was substantially better, (b) subjects with 10th grade reading ability performed consistently better than those with 8th grade ability, (c) greater literacy gaps led to poorer comprehension, but the effect of this variable was relatively small, and (d) longer reading times led to greater comprehension. However, comprehension did not increase in proportion to the amount of additional reading time; that is, a large amount of additional time invested in reading resulted in only a modest gain in comprehension. It should be noted that the effects, though statistically significant, were small and that the largest effect was due to subject matter rather than any of the variables of experimental interest.

The following recommendations for the Air Force were made: (a) before major efforts are undertaken to rewrite Air Force materials for greater ease of reading, it would seem expedient to determine how much a negative literacy gap influences actual job performance, (b) efforts to improve readability of materials should be directed at populations and situations where motivation and interest are unlikely to be high, and (c) while increasing reading time would seem to be a

reliable and straightforward way to increase test comprehension, the results of this study indicated that the learning efficiency of this approach is not high. Therefore, in applying this approach to particular situations, it may be well to carefully analyze whether the gain in comprehension is worth the extra expenditure of reading time. (64 pages)

23 **Purifoy, G.R., Jr., & Benson, E.W. Maintenance training simulators design and acquisition: Summary of current procedures. AFHRL-TR-79-23, AD-A079 636. Lowry AFB, CO: Technical Training Division, November 1979. Project 2361, Contract F33615-78-C-0019, Applied Science Associates, Incorporated. NTIS.** This technical report is the first in a series that will explore the problems of maintenance training simulation design and acquisition. It is focused on the existing procedures followed by Air Force personnel in performing Instructional Systems Development (ISD) analyses to define maintenance training equipment requirements, and by System Program Office (SPO) Training Equipment Acquisition Managers in accomplishing training equipment procurement. Later reports in this series will structure appropriate functional specifications for the acquisition of maintenance training simulators, will present handbooks to guide ISD analysts in selecting appropriate types of maintenance training equipment and in designing and documenting required maintenance training simulator characteristics and features, and to guide SPO Acquisition Managers in preparing Prime Item Specifications.

In this report both the ISD and SPO procedures are described as they are currently accomplished. Relevant documentation is cited and a comprehensive bibliography is included. For each of the two sets of procedures, a general decision model is presented as a reference, and general problem areas which appear to be degrading the ultimate cost-effectiveness of maintenance simulators are discussed. (86 pages)

24 **McManus, J.C. Equipment comparability techniques used during early system design. AFHRL-TR-79-24, AD-A071 411. Wright-Patterson AFB, OH: Advanced Systems Division, July 1979. Project ASDS. NTIS.** A simple and accurate process is needed for comparing proposed equipment to existing operational equipment in order to forecast the resources required to support the proposed equipment. Maintenance manpower modeling needs such a process to predict manpower, spares, and support equipment of newly designed weapon systems.

As a first step toward developing the needed techniques for comparing old and new equipment, a systematic study was made of the present state-of-the-art. Current literature was reviewed, personnel who perform comparability analysis were interviewed, and past comparability studies were analyzed. This effort found that a distinction should be made between the broad topic of "comparability studies" and the specific procedures of "comparability analysis." A comparability study is the overall process used to estimate resource requirements for new equipment using the procedures of comparability analysis to find operational equipment which is similar to the proposed equipment.

It also was found that no standardized, reliable procedure exists for performing comparability studies including comparability analysis. It is recommended that a quantitative procedure be developed for comparing new equipment with equipment in the operational inventory. It is further recommended that a quantitative procedure be developed for computing an adjustment factor relating the operational equipment to the proposed equipment. (14 pages)

25 **Nataupsky, M., Waag, W.L., Weyer, D.C., McFadden, R.W., & McDowell, E. Platform motion contributions to simulator training effectiveness: Study III — Interaction of motion with field-**

of-view. **AFHRL-TR-79-25, AD-A078 426. Williams AFB, AZ: Flying Training Division, November 1979. Project 1123. NTIS.** The objective of this study was to determine the effects of platform motion cueing, visual field of view (FOV), and their interaction upon learning in the simulator and as subsequent transfer of training to the aircraft for basic contact maneuvers in the T-37 aircraft. A transfer-of-training study design was used in which student pilots were initially trained in the Advanced Simulator for Pilot Training (ASPT) and subsequently evaluated on their first sortie in the T-37 aircraft. Each student received training under one of four simulator configurations: (a) full platform motion (six degrees of freedom), full FOV (300° horizontal by 150° vertical); (b) full platform motion, limited FOV (48° horizontal by 36° vertical); (c) no platform motion, full FOV; and (d) no platform motion, limited FOV. for the ASPT pretraining phase, scores from the automated performance measuring system and overall instructor pilot ratings were used for analysis. For the T-37 evaluation sorties, the overall instructor pilot ratings, as well as individually recorded flight parameters, were analyzed. These data provided no conclusive evidence of differential transfer effects resulting from platform motion cueing, size of the visual FOV, or their interaction. As such, these data provide support for previous findings that platform motion cueing does not significantly enhance the transfer of learning for basic contact tasks in the T-37 aircraft. It would seem that the impact of peripheral visual cues for initial acquisition is not critical. Furthermore, no convincing evidence was found indicating increased transfer using platform motion in conjunction with a narrow FOV visual scene. The major implication from these findings is that a fixed-base, limited FOV simulator configuration provides sufficient cueing for basic contact skills normally trained during Undergraduate Pilot Training. (30 pages)

26 **Williams, R.J. Air Force Human Resources Laboratory Annual Report—Fiscal Year 1978. AFHRL-TR-79-26, AD-A069 739. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, May 1979. (Covers all AFHRL projects.) NTIS.** This report comprehensively describes the organizational structure of the Air Force Human Resources Laboratory and the functions of its Divisions and Operating Locations. It presents the technical achievements of the Laboratory for Fiscal Year 1978, synopsizes promising on-going research projects, discusses the available technical resources, and lists publications and presentations by Laboratory personnel during Fiscal Year 1978. (88 pages)

27 **Soland, D., Voth, M., & Narendra, P. Real-time feasibility for generation of nonlinear textured terrain. AFHRL-TR-79-27, AD-A095 070. Williams AFB, AZ: Operations Training Division, January 1981. Project 1958, Contract F33615-77-C-0073, Honeywell, Systems and Research Center. NTIS.** This study was conducted by Honeywell for the Air Force Human Resources Laboratory (AFHRL) in order to evaluate and study a potential new approach for the simulation of visual and sensor imagery for Air Force training applications. This report describes the hardware implementation of a curved-surface method for computer image generation (CIG) of textured terrain imagery. General comments and details of the algorithms are presented. This is followed by a discussion of the hardware for a real-time implementation of this technique.

The approach involves the display of terrain as curved surfaces represented by bicubic splines. Texture patterns may then be mapped to these surfaces. Buildings or man-made features may be drawn using polygonal surfaces.

This curved approach is of interest because it may represent a more cost-effective method to include more detail in the simulated imagery. Current systems are constrained to the use of straight edges in the representation of real-world features and require large numbers of edges to display complex, irregular objects such as terrain. Therefore, the curved surface approach may demonstrate many advantages over the straight edge technique. (114 pages)

28 **King, G.F., & Askren, W.B. Human resources, logistics, and cost factors in weapon system development: Demonstration in conceptual and validation phases of aircraft system acquisition. AFHRL-TR-79-28(I), AD-A075 272. Wright-Patterson AFB, OH: Advanced Systems Division, September 1979. Project 1959, Contract F33615-77-C-0016, Dynamics Research Corporation. NTIS.** A methodology, the coordinated human resource technology (CHRT), was developed to quantify critical human resource, logistics, and cost factors throughout aircraft acquisition. Knowledge of these factors helps influence the selection of a system and support design approach. The factors quantified are manpower, training, technical documentation, and system ownership costs. Reliability and maintainability, both of which directly affect the foregoing, are also quantified. The CHRT methodology also implements an integrated approach to personnel, training, and technical documentation, and operates from a single, evolving consolidated data base.

This report describes two parts of a three-part demonstration of CHRT application on an aircraft acquisition program. Parts 1 and 2, respectively, use conceptual and validation (prototype) phase data on avionics and landing gear systems of the Advanced Medium STOL[1] Transport (AMST). The results are presented and evaluated for various design, personnel, training, and technical data alternatives. CHRT is demonstrated as an acquisition management tool which initiates the development of detailed logistic and cost data early in acquisition and provides data source continuity throughout acquisition. Part 3 of the demonstration will use data projected for the AMST minimum engineering development (MED) phase. This phase is similar to full-scale development. (96 pages)

29 **King, G.F., & Askren, W.B. Human resources, logistics, and cost factors in weapon system development: Demonstration in conceptual and validation phases of aircraft system acquisition — Appendix A. AFHRL-TR-79-28(II), AD-A075 209. Wright-Patterson AFB, OH: Advanced Systems Division, September 1979. Project 1959, Contract F33615-77-C-0016, Dynamics Research Corporation. NTIS.** The Coordinated Human Resource Technology and the Consolidated Data Base have been demonstrated in the conceptual and validation phase of weapon system acquisition. The results of this demonstration are reported in AFHRL-TR-79-28(I). This report (Volume II) constitutes Appendix A to that demonstration report and provides additional details of the demonstration. (116 pages)

30 **Hendrix, W.H., Ward, J.H., Jr., Pina, M., Jr., & Haney, D.L. Pre-enlistment person-job match system. AFHRL-TR-79-29, AD-A078 427. Brooks AFB, TX: Occupation and Manpower Research Division, September 1979. Project 2077. NTIS.** Research discussed in this report involved the development of a computer-based assignment system which became operational Air Force wide 1 November 1976. The Person-Job Match System was the computer algorithm which matched potential recruits with available jobs. This algorithm, when operationally implemented, became the assignment algorithm of the Air Force Advanced Personnel Data System's Procurement Management Information System (APDS-PROMIS). This report presents the assignment concept, methods of combining multiple objectives, the conceptual payoff equation, baseline performance data, and future directions anticipated. (98 pages)

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[1]Short takeoff and landing.

31 **Kraft, C.L., Anderson, C.D., & Elworth, C.L. Psychophysical criteria for visual simulation systems. AFHRL-TR-79-30, AD-A084 776. Williams AFB, AZ: Operations Training Division, May 1980. Project 6114, Contract F33615-78-C-0012, Boeing Aerospace Company. NTIS.** This contractual effort studied a prioritized list of psychophysical aspects of visual simulation systems for military flight training simulators. The available literature, operational experiences of simulator commands, current research program data were assembled, organized, reviewed, evaluated and summarized to provide psychophysical criteria for the visual displays subsystem. Areas of insufficient data were identified, and seven experimental designs were suggested for psychophysical investigations to provide some of the missing data. (144 pages)

32 **Hendrix, W.H., & Halverson, V.B. Personnel and background differences in organizational effectiveness. AFHRL-TR-79-31, AD-A090 102. Brooks AFB, TX: Manpower and Personnel Division, September 1980. Project 2313. NTIS.** Research involved a series of one-way and two-way analyses of variance (ANOVA) to establish significant differences between response options associated with Background Information items from the Organizational Assessment Package (OAP). Significant main effects and interactions resulted in tests for simple main effects and post-hoc analyses to establish specific mean pairs which differed significantly from each other. Four criteria which served as dependent variables in the ANOVAs were (a) General Organizational Climate, (b) Organizational Communications Climate, (c) Job Related Satisfaction, and (d) Perceived Productivity. These criteria were collected with the OAP, and were four orthogonal factors extracted during a previous study. A few of the significant differences found were that, overall, those who were in an organization more than 36 months scored higher on the criteria than did other groups of individuals. Supervisors of larger numbers of people also scored higher than did other groups of individuals. A supervisor who used work group meetings to set goals and solve problems resulted in his workers being more satisfied, and perceived productivity and the organization's climate to be better. Civilians reported higher job related satisfaction than did officers and airmen. Airmen perceived work group productivity to be lower than did officers and civilians. (90 pages)

33 **Rueter, F.H., Hillman, R.G., & Bell, T.R. Design of a national skills market model for Air Force enlisted personnel. AFHRL-TR-79-32, AD-A075 273. Brooks AFB, TX: Occupation and Manpower Research Division, September 1979. Project 2313, Contract F33615-78-C-0029, CONSAD Research Corporation. NTIS.** This technical report documents the detailed specifications developed in this study describing feasible options available for designing and implementing the National Skills Market Model—an empirically based forecasting model of economic activity in the industrial and occupational labor markets in which the Air Force competes for labor. Essentially, the model formulated in this study consists of three basic analytic components which, in combination, produce detailed forecasts of national labor market conditions, and generate projections of the total accession and retention of Air Force enlisted personnel. The basic analytic components include a non-military labor market module, a population projection module, and an accession/retention rate forecasting module. Each of these components is then subdivided into one or more analytic elements which address distinct aspects of the general issue examined in the analytic component. In all, nine analytic elements are included in the modular design of the model. The report describes the functions to be performed by each of the analytic components and elements, and specifies the procedures through which each element has been designed to accomplish its functions. Recommendations for the development and implementation of the model are presented also. Detailed supporting information is provided in appendices. (180 pages)

34 **Kalisch, S.J., Jr. Computerized instructional adaptive testing model: Formulation and validation. AFHRL-TR-79-33, AD-A081 855. Lowry AFB, CO: Technical Training Division, February 1980. Project 2313, Contract F33615-77-C-0071, Control Data Education Company.**

NTIS. The study included a formulation of eight versions of an adaptive testing model and computer simulations used to compare the accuracy and efficiency of the versions to each other and to conventional testing modes. The adaptive testing model was designed to be applicable to the needs and problems incurred in assessing mastery/non-mastery of instructional objectives by trainees. The overall purpose was to design a testing model that could provide greater accuracy in mastery/non-mastery classifications with fewer test items than are presented with conventional tests. The study included two phases of computer-simulated tests of the models. The first phase employed Monte Carlo simulations; the second used existing data obtained from trainees in a Weapons Mechanics training course. The results of the first phase showed that one of the versions was superior in accuracy to a conventional testing procedure. Although the other versions provided the same accuracy as the conventional mode, selection of other error parameters would probably be able to increase the accuracy of the adaptive testing versions. All the adaptive versions required significantly fewer items to make mastery/non-mastery decisions. In the second phase, two of the adaptive versions were selected for comparison using data from actual trainees. The results showed the adaptive testing models could provide the same decisions as are made now by the Air Force in the Weapons Mechanics course, except that on the average 75 percent fewer test items would be needed. It was concluded that the adaptive testing model could be used to substantially reduce testing time and maintain the present level of accuracy in decision making, not only in Weapons Mechanics but also in other courses requiring the same types of decisions. (106 pages)

35 **Thomas, E.L., & Hankins, R.J. Use of human resources data in weapon system design: Identification of data/data systems and related technology. AFHRL-TR-79-36, AD-A080 598. Wright-Patterson AFB, OH: Advanced Systems Division, January 1980. Project 1124, Contract F33615-78-C-0010, Clemson University. NTIS.** The objective of this study is to establish criteria for development of a Unified Data Base of human resources information for use in system design. Existing data, data systems, and technology related to the use of human resource factors in weapon system design are identified and briefly discussed. Topics discussed include Maintenance Data Collection System, Maintenance Cost System, Human Resources Technology, Life Cycle Costing, Air Force Logistic Command Data Systems, Parametric Estimating Relationships, and data systems other than Air Force. (134 pages)

36 **Gray, T.H. Boom operator part-task trainer: Test and evaluation of the transfer of training. AFHRL-TR-79-37, AD-A079 796. Williams AFB, AZ: Flying Training Division, October 1979. Project 1123. NTIS.** The report presents the rationale, methodology and results of a study of the training capabilities of the Boom Operator Part-Task Trainer (BOPPT), an air refueling simulator. The study was performed as part of an Air Force Initial Operational Test and Evaluation (IOT&E) of the device. Actually, three transfer of training sub-studies were conducted simultaneously: the first with undergraduate boom operators in the Combat Crew Training Squadron (CCTS) phase of instruction; the second with instructor boom operators in the Central Flight Instructor Course (CFIC); and the third with highly experienced boom operators who were maintaining essential skills.

In the CCTS application, it was found that all student groups trained in the BOPTT required significantly fewer air refueling attempts (50 versus 71) to reach proficiency in KC-135A air refueling skills than did conventionally trained students. In boom operations, procedures, and communications, the BOPTT trained students were equal or superior to the students in the standard syllabus. Also, proper utilization of the BOPTT could avoid over one million dollars in training costs per year.

For the CFIC application, the data show that trainees who received all training sessions in the BOPTT demonstrated proficiency equal to that of instructor trainees who received all training in the KC-135A aircraft. The 1:1 training transfer ratio afforded by the direct substitution of BOPTT training for aircraft training is striking confirmation of device effectiveness.

Finally, the skill maintenance data revealed that no measurable degradation of boom operator skills occurred for the duration of the two test periods (60 and 120 days). Consequently, no conclusions could be drawn concerning the effectiveness of the BOPTT in maintaining the proficiency of highly skilled boom operators. (70 pages)

37 **Bailey, J.S., & Hughes, R.G. Applied behavior analysis in flying training research. AFHRL-TR-79-38, AD-A081 750. Williams AFB, AZ: Flying Training Division, January 1980. Project 1123. NTIS.** Research developments in learning theory over the past 50 years have led to principles of behavior which have been shown in innumerable applied settings to be valuable in analyzing and modifying human behavior. When applied to flying training using simulators, these principles suggest that a significant contribution could be made in improving the way in which Instructor Pilots teach new students via more effective use of simulator functions. In addition, flying skills could probably be acquired more readily if tasks were presented in a more systematic manner, taking the principles of learning into account. When the simulator is conceptualized as merely an inferior copy of an aircraft, its potential as a teaching device (perhaps superior to the actual plane, in this regard) is likely to be overlooked. Thus, a behavioral analysis of optimal conditions of learning would make a major contribution to both the design and use of current and future flight simulators. In this report, an attempt is made to elucidate the basic principles of behavior and to relate them to the task of improving flying training. (18 pages)

38 **Marcus, G.H., Patterson, J.T., Bennett, C.D., & Gershan, B.S. Cost-effectiveness methodology for aircrew training devices: Model development and users handbook. AFHRL-TR-79-39, AD-B044 765L. Williams AFB, AZ: Flying Training Division, February 1980. Project 1123, Contract F33615-77-C-0072, Analytic Services Incorporated. DTIC.** This report documents the development of a new methodology to examine the cost-effectiveness of alternative aircrew training devices and systems. The methodology is comprehensive and highly flexible and uses detailed cost and training information on the devices and the training program. The report is intended to be useful both as a reference on the technical aspects of the model development and as a users handbook for operating the computer software. (256 pages)

39 **Lintz, L.M., Pennell, R., & Yasutake, J.Y. Integrated system test of the Advanced Instructional System (AIS). AFHRL-TR-79-40, AD-A081 854. Lowry AFB, CO: Technical Training Division, December 1979. Project 1193, Contract F33615-73-C-4004, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** The integrated system test for the Advanced Instructional System (AIS) was designed to provide quantitative answers regarding the training time reductions resulting from certain computer-managed instruction (CMI) functions of the AIS. The reliabilities of the CMI functions and of the AIS support systems (media, computer hardware, and software) were also investigated.

Testing established that conversion of the conventional lockstep Inventory Management (IM) course to self-pacing with basic CMI functions reduced training time by 35%. In the Material Facilities (MF) course, the reduction was 24%; in Precision Measuring Equipment (PME), 31%; and in Weapons Mechanic (WM), 31%. Student progress management (SPM), an additional CMI capability which gives frequent feedback to the student and instructor regarding the student's progress toward a computer-generated target graduation date, resulted in additional savings of 10% in IM, 6.7% in MF, 5.1% in PME, and 13.5% in WM. Individualized instructional assignment (IIA), another CMI

capability whereby a student is assigned to those alternative instructional treatments that are predicted to be best for that student, resulted in additional savings in the IM course—individualization in one-fourth of the course reduced the average time in course by 3%.

Reliability and maintainability data collected during the integrated system test indicated that the CMI support functions, the media devices and courseware, and the computer hardware and software met or exceeded AIS requirements.

The lessons learned during AIS development were extrapolated to provide estimates of courseware development times that should be realizable in converting lockstep instruction to AIS computer-based instruction. (106 pages)

40 **Elworth, C. Instructor/operator display evaluation methods. AFHRL-TR-79-41, AD-A097 208. Williams AFB, AZ: Operations Training Division, March 1981. Project 6114, Contracts F33615-77-C-0017 and F33615-78-C-0051, Boeing Aerospace Company, NTIS.** The purpose of this study was to develop an objective, systematic technique for evaluating alternative formats for the displays to be used at the instructor/operator station (IOS) of a flight simulator. A benchmark performance monitoring task was designed which exercises many of the skills used by an instructor at a remote IOS. Measurement techniques were developed for assessing performance of the task. The techniques were demonstrated by using them to compare two popular display formats: digital readouts versus repeater instruments. Three of six variables were monitored with greater accuracy and comprehensiveness using repeater instruments than digital readouts. For the other three variables, there was no difference between display types. Significant effects were caused by both the type of maneuver being flown and the type of question being asked in administering the measurement method. We concluded that the benchmark task approach has considerable merit as a method of evaluating display formats. In follow-on studies, additional investigations should be conducted on the specifics of the measurement technique and the possible effects of memory on results. (192 pages)

41 **Lintz, L.M., Tate, T., Pflasterer, D.C., Nix, C.J., Klem, T.G., & Click, L.E. Low-Cost Computer-Aided Instruction/Computer Managed Instruction (CAI/CMI) system: Feasibility study. AFHRL-TR-79-42, AD-A081 072. Lowry AFB, CO: Technical Training Division, December 1979. Project 1121, Contract F33615-78-C-0031, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** This study investigated the feasibility of a low-cost computer-aided instruction/computer-managed instruction (CAI/CMI) system. Air Force instructors and training supervisors were surveyed, to determine the potential payoffs of various CAI and CMI functions. Results indicated that a wide range of capabilities had potential for resident technical training. Surveys of selected computers, terminals, communications, and support software identified candidates for the low cost system. (154 pages)

42 **Dobrovolny, J.L., McCombs, B.L., & Judd, W.A. Study skills package: Development and evaluation. AFHRL-TR-79-43, AD-A083 232. Lowry AFB, CO: Technical Training Division, March 1980. Project 1121, Contract MDA-903-77-0144, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** Materials contained within this report are designed to diagnose and remedy student study skill deficiencies in the areas of (a) reading comprehension, (b) memorization, (c) test taking, and (d) concentration management skills. The study skills materials were separately packaged to allow partial or total remediation in the four areas, as required, and each package incorporated concepts of active student involvement in the material to be learned (e.g., mnemonic techniques, behavioral self-control strategies). In addition, materials and procedures

used in an Instructor Orientation and Training Workshop are included. A package was designed to provide instructors using computer-managed instruction with basic diagnostic and tutorial skills required to assist in their effective use of the study skills materials and to help them transition into their new role as facilitator of student learning. Evaluation data from an implementation of the student and instructor skill training materials in the Air Force Advanced Instructional System suggest that consistent student training time reductions and performance gains can be obtained by the use of the study skills materials. The Study Skills Questionnaire was also found to be a reliable and valid measure of student skills in the four areas, and reliably discriminated students performing satisfactorily versus poorly in the Advanced Instructional System technical training environment. Furthermore, the Instruction Orientation and Training was found to assist in the efficient remediation of student study skill deficiencies and to contribute to improved instructor perceptions of their role in computer-managed instruction. (190 pages)

43 **DeMaio, J.C., & Eddowes, E.E. Airborne performance measurement assessment: Low altitude tactical formation in two operating environments. AFHRL-TR-79-44, AD-A087 068. Williams AFB, AZ: Operations Training Division, July 1980. Project 1123. NTIS.** A methodology was developed to assess pilot performance in low altitude tactical formation (LATF) and to relate overall performance to performance on subtasks necessary to mission success. The methodology was employed to evaluate the performance of 28 pilots assigned to an operational A-7 squadron. The methodology was found to provide a consistent measure of pilot performance and to reveal the importance of certain pilot skills to the LATF task. Performance ratings were obtained under routine operating conditions and under conditions of simulated combat. Differences were obtained in performance ratings under the two conditions. Implications for currency training were discussed. (18 pages)

44 **Eschenbrenner, A.J., Jr., DeVries, P.B., Jr., Miller, J.T., & Ruck, H.W. Methods for collecting and analyzing task analysis data. AFHRL-TR-79-45(I), AD-A087 710. Brooks AFB, TX: Manpower and Personnel Division, July 1980. Project ILIR, Contract F33615-77-C-0076, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** Task analysis, a critical front-end activity in the Instructional System Development methodology, is the process of partitioning job tasks into their component subtasks and identifying the skills and knowledges required to support task performance. This study was initiated in response to a Request for Personnel Research generated by the Air Training Command, which noted that "a wide range of nonstandardized task analysis procedures are in use throughout the training community." Implementation of a standardized procedure for identifying essential subtasks and supporting skills and knowledges was expected to hold considerable potential for increasing training efficiency and reducing training costs. A simplified task analysis procedure and documentation system was specified, and a task analysis handbook was prepared. Handbook procedures were field tested at six Air Force installations. Results indicated that the handbook procedures met the design criteria of simplicity, validity, reliability, and time-efficiency/effectiveness. The feasibility and utility of implementing a computer-based task analysis data bank was assessed, and a preliminary data bank design was then developed. Additionally, two technology transfer seminars were conducted to assist Air Force personnel in applying handbook task analysis procedures. (174 pages)

45 **DeVries, P.B., Jr., Eschenbrenner, A.J., Jr., & Ruck, H.W. Task analysis handbook. AFHRL-TR-79-45(II), AD-A087 711. Brooks AFB, TX: Manpower and Personnel Division, July 1980. Project ILIR, Contract F33615-77-C-0076, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** The handbook provides a validated set of procedures and guidelines for analyzing tasks into subtasks and supporting skills and knowledge. The handbook is designed for use in technical training by subject matter experts. It assumes that tasks have already been selected for

training, that trainee proficiency levels have been determined, and that the trainee population is known.

There are three major stages of the task analysis procedure contained in the handbook. They are: (a) Development of preliminary performance requirements (PPRs), (b) Identification of subtasks, (c) Identification of supporting skills and knowledge. (72 pages).

46 **Hendrix, W.H. Organizational assessment indices of effectiveness. AFHRL-TR-79-46, AD-A081 073. Brooks AFB, TX: Occupation and Manpower Research Division, December 1979. Project 2313. NTIS.** The research discussed in this report involved developing indices of effectiveness to be used operationally with the Organizational Assessment Package (OAP). The OAP is primarily an attitudinal survey developed for use by the Air Force Leadership and Management Development Center. Analyses compared job enrichment formulas to establish the most predictive system for predicting four organizational criteria. Regression equations were developed for estimating the true factor scores of OAP factors. This provided a means of estimating factor scores from a small sub-set of items, thereby reducing the number of survey items required to reliably establish factor score measures. Regression equations were developed using variables from the job and supervisor inventories of the OAP for predicting the OAP criterion inventories. These equations provide estimates of criterion scores when circumstances prohibit administration of the entire OAP and the criterion inventories have been excluded to shorten OAP length. (58 pages)

47 **Lindholm, E., Ruppel, M., & Buckland, G.H. Attention and task complexity as indicated by physiological indices. AFHRL-TR-79-47, AD-A080 851. Williams AFB, AZ: Flying Training Division, December 1979. Project 2313, Contract F33615-77-C-0069, Arizona State University. NTIS.** The objective of this research was to develop physiological measures of pilot attention and workload for use in flight simulation research studies. In later studies, these physiological measures would then be used in conjunction with behavioral measures of pilot attention and task difficulty in order to optimally structure flight simulation training programs and equipment. This research employed two common behavioral information processing tasks in order to study four physiological variables, namely, heart rate, skin conductance, eye movement, and cortical evoked response, as measures of attention and arousal. Four separate information processing experiments were conducted involving both choice reaction time and letter matching tasks. For the choice reaction time tasks, the faster responses were in general associated with increased measures of arousal as indicated by heart rate, skin conductance, and evoked potential amplitude. There was no general arousal effect produced for the letter matching tasks; however, the cortical evoked response varied systematically and reliably with task difficulty and reaction time. In this regard, simple decision evoked short latency low amplitude brain waves, while more difficult decisions evoked longer latency, higher amplitude brain waves. Thus, the heart rate and skin conductance measures of arousal reflected, in a gross sense, the degree of subject involvement in the task, and the evoked potential components varied reliably with task difficulty and performance. (34 pages)

48 **Micalizzi, J., Coward, R.E., & Nelson, W.H. Simulator training effectiveness as a function of error counts on the F-15A flight simulator instructor operator station. AFHRL-TR-79-48, AD-A081 074. Williams AFB, AZ: Flying Training Division, December 1979. Project 1123. NTIS.** Effective simulator training is an important factor in the Air Force's overall ability to train pilots. A major problem is that simulator managers tend to assume that their machines are always optimally designed and used. In addition, investigators find it difficult to evaluate simulator training in quantitative terms while working in an operational setting. These problems reflect the need for the Air Force to carefully consider current and future simulator designs and training programs. This study was designed to investigate procedural errors made at the F-15A Simulator

Instructor/Operator Station (IOS) by instructor pilots (IPs). An observer recorded the number of errors and the time needed to correct each error during a typical 90-minute session. Questionnaires were filled out by 34 F-15 aircraft IPs and 16 F-15 simulator operators indicating their respective simulator experience. Data were collected during actual training missions to determine if IP errors seriously detracted from training time. The results showed that the average number of errors and average error time had an insignificant impact on simulator training. The number of simulator sessions flown by each IP in the course of the present study was identified as an important factor in effective simulator training, varying inversely with error counts. However, no relationship was found between total IP hours and average error count. In addition, the electronic tactics selected by the IP may have had an effect on average error count. Additional research is needed to determine if IOS modification will increase simulator training effectiveness. (18 pages)

49 **Mulligan, J.F. Logic tree troubleshooting aids: Organizational and intermediate maintenance. AFHRL-TR-79-49, AD-A079 777. Wright-Patterson AFB, OH: Advanced Systems Division, January 1980. Project 1710, Contract F33615-78-C-0015, Management and Technical Services Company. NTIS.** This report provides a draft military specification for use in the procurement of Logic Tree Troubleshooting Aids (LTTAs). Recent research has demonstrated that the use of LTTAs can significantly improve the efficiency and effectiveness of maintenance personnel in performing troubleshooting tasks. The use of LTTAs results in quicker location of faults and reduced consumption of spare parts. However, at present there is no specification available for the procurement of LTTAs. The draft specification was developed to fill this need.

A thorough review of the state of the art in preparing and using LTTAs was made to provide the basis for developing the draft specification. This was accomplished by reviewing available literature and then conducting extensive interviews with government and industry personnel with experience in developing, using, and evaluating LTTAs. The results of the interviews were analyzed to provide the basis for establishing the requirements for developing LTTAs. The goal was to develop a specification which establishes basic requirements for developing LTTAs which will result in improved performance while still providing enough flexibility to be suitable for application to a wide variety of applications.

The draft specification provides specific and general requirements for the development of LTTAs. These include requirements for (a) task analysis, (b) development of troubleshooting procedures, (c) development of checkout procedures, (d) presentation formats, (e) preliminary information, (f) supplemental and support information (wiring diagrams, theory of operation, etc.), (g) varying levels of enrichment, and (h) dual level presentation. The specification is suitable for use in procuring LTTAs for use with all types of equipment: electrical, electronic, mechanical pneumatic, hydraulic, optical and combinations thereof. It is suitable for procurement of LTTAs for use at the intermediate and organizational levels of maintenance. The specification may also be used for the development of checkout and logic tree procedures for use in other types of manuals. (116 pages)

50 **Lobel, A.E., & Mulligan, J.F. Maintenance task identification and analysis: Organizational and intermediate maintenance. AFHRL-TR-79-50, AD-A083 685. Wright-Patterson AFB, OH: Advanced Systems Division, January 1980. Project 1710, Contract F33615-78-C-0015, Management and Technical Services Company. NTIS.** This report provides a draft military specification for use by Air Force and other DoD agencies in specifying the requirements for maintenance task identification and analysis (MTI&A). Several new types of technical data, such as job guide manuals (JGMs) and logic tree troubleshooting aids (LTTAs), have been adopted for use by the Air Force. The development of accurate and effective JGMs and LTTAs requires that a thorough MTI&A be accomplished to prepare the data base from which JGMs and LTTAs are

developed. At present there is no suitable specification available to establish MTI&A requirements for use in procuring JGMs and LTTAs. The draft specification was developed to fill this need.

A thorough review of the state-of-the-art in performing the MTI&A was accomplished to provide the basis for developing the draft specification. This was accomplished by first reviewing the literature in the area and then conducting extensive interviews with government and industry personnel who are knowledgeable of and experienced in current MTI&A procedures. Interviews were conducted with industry personnel who have had experience in conducting research to develop MTI&A procedures, and with personnel who have had experience in managing and conducting MTI&A programs. Interviews were also conducted with Air Force and Army personnel who have had experience in procuring MTI&A based technical data. The results of the literature review and interviews were analyzed and used to provide the basis for developing the MTI&A requirements included in the specification.

The draft specification requires that the contractor accomplish specific tasks to insure that all required maintenance tasks are identified and that all information required to prepare effective JGMs and LTTAs is developed. The tasks include the development of (a) a task identification matrix to identify all required tasks and specify the level of maintenance (intermediate, organizational, depot) at which they are to be performed, (b) a description of the intended user (abilities, training, experience), (c) listings of required support equipment and special tools, (d) guidelines for determining the level of detail to be included in JGMs and LTTAs, (e) an analysis of possible equipment faults and resulting symptoms, (f) effective step-by-step procedures for accomplishing each task, and (g) action trees outlining a troubleshooting strategy to isolate each possible fault. A special section is provided for accomplishing the MTI&A for systems for which Logistic Support Analysis data are available. The draft specification is suitable for the procurement of MTI&A for organizational and intermediate levels of maintenance. The specification establishes firm requirements for conducting the MTI&A but allows the contractor considerable freedom in how he accomplishes the analysis. The specification may be used to procure MTI&A for the development of a data base for use in developing other types of manuals. (124 pages)

51 **Martin, E.L. Training effectiveness of platform motion: Review of motion research involving the advanced simulator for pilot training and the simulator for air-to-air combat. AFHRL-TR-79-51, AD-A095 930. Williams AFB, AZ: Operations Training Division, February 1981. Project 1123. NTIS.** This report presents a summary review of the transfer-of-training studies conducted by the Operations Training Division of the Air Force Human Resources Laboratory investigating the training effectiveness of six-degrees-of-freedom platform motion cueing. A total of six studies are reviewed. Of the six studies, five were conducted on the Advanced Simulator for Pilot Training (ASPT) located at Williams AFB and one on the Simulator for Air-to-Air Combat (SAAC) located at Luke AFB. Tasks investigated included basic and advanced contact, instruments, basic fighter maneuvers, and conventional weapons delivery. The review of each study contains a statement of objectives, a summary of the method and results, a data excerpt representative of the findings, and a critique. The report also contains a description of the research strategy from which the studies were derived, a discussion of transfer-of-training methodology, and a discussion of the relationship between the results of these six studies and research findings from other agencies or facilities. Implications for future research are discussed. (32 pages)

52 **Hughes, R.G., Hannan, S.T., & Jones, W.E. Application of flight simulator record/playback feature. AFHRL-TR-79-52, AD-A081 752. Williams AFB, AZ: Flying Training Division, December 1979. Project 1123. NTIS.** Undergraduate Pilot Training (UPT) students acquired a complex visual flying task in ASPT under one of three instructional conditions which differed in

their use of an automated record/playback feature. The study evaluated differences in performance resulting from (a) periodic, repeated use of a recorded, instructor-presented demonstration, (b) periodic use of a replay of student performance, and (c) use of equivalent training time for additional practice.

The data indicated little or no instructional value associated with repeated exposures to the original demonstration of the task to be learned. While the "replay" condition produced terminal performance with fewer errors on the average than the "demo" condition, differences between "practice" and "replay" groups were not statistically significant. The surprising finding of the study was the effectiveness of simple practice relative to that of the two, so-called, "instructional" conditions. These data would suggest that, at least in some instances, a training approach that provided only for basic performance feedback (e.g., a "score") might be equally as effective as one with provision for presenting repeated access to recorded demonstrations and/or replays of previous performance. (16 pages)

53 **Mullins, C.J., Earles, J.A., & Wilbourn, J.M. Calculation of predictor composites in the absence of a criterion. AFHRL-TR-79-53, AD-A080 921. Brooks AFB, TX: Personnel Research Division, December 1979. Project 2313. NTIS.** Sometimes a prediction battery is needed for a specialty in which no adequate criterion is obtainable within a reasonable period of time. This is the second study into two techniques for producing a criterion synthetically. One technique (called R-Technique) involves the rating by experts of 100 profiles showing all the predictor variables under consideration. Another (the M-Technique) involves the rating of factors by the same experts. In both instances, the synthetic criterion data are used to produce weights for the predictors. In order to check the efficiency of the prediction composites emerging from the use of the synthetic criteria, they are compared with a cross-validated composite obtained in the usual manner. Synthetic composites in the earlier study were predicted as well as the empirical composite; however, in this study, the results were much poorer. There are differences in predictive efficiency across the four technical schools studied, across the three sets of predictor variables used, and across the kinds of experts used (psychologists, instructors, and adminstrative airmen). There are also differences in efficiency associated with the size of the expert groups, with larger groups producing more effective composites. (38 pages)

54 **Looper, L.T., & Beswick, C.A. Recruiting resource and goal allocation decision model. AFHRL-TR-79-55, AD-A080 747. Brooks AFB, TX: Occupation and Manpower Research Division, January 1980. Project 2077. NTIS.** This report presents an attempt to construct a mathematical model that could be used to allocate Air Force recruiter effort based on recruiting organization and demographic data available at the Air Force Recruiting Office level. Such a model based on a non-linear market response function and a dynamic programming allocation routine was developed and tested with actual Air Force data. The model was one already formulated and tested in a sales force marketing environment. With the aid of the model designer, it was modified to meet Air Force Recruiting Service needs and data availability. The model has been further modified to include several Recruiting Service organizational requirements. Validation of the model against actual Recruiting Service allocation decisions was performed and model resource allocations were close to management decisions. Suggestions as to management use of the model in forecasting and recruiter productivity are also made in the report. (14 pages)

55 **Martin, E.L., & Catanco, D.F. Computer generated image: Relative training effectiveness of day versus night visual scenes. AFHRL-TR-79-56, AD-A088 313. Williams AFB, AZ: Operations Training Division, July 1980. Project 1123. NTIS.** A transfer-of-training design was used to

compare the relative training effectiveness of day and night visual scenes for the acquisition of takeoff and landing skills in the novice pilot in daylight flight conditions. Twenty-four undergraduate pilot trainees with no previous jet piloting experience were randomly assigned to one of the three treatment groups (n = 8): Day, Night, and Control. Those students assigned to the Control group received the standard syllabus of preflight and flightline instruction. The students in the two experimental groups received three sorties in the Advanced Simulator for Pilot Training (ASPT) covering instruction of takeoff, straight-in approach and landing, and straight-in approach to a touch-and-go. ASPT trained students received the same amount of training on each task with performance evaluated periodically with the ASPT's automated performance measurement system (APM), as well as with performance ratings supplied by the instructor pilot (IP). The only difference in training conditions was the use of either a day or night runway environment visual scene. The field of view of the visual display was limited by a computer mask to 48° horizontal by 36° vertical. Following completion of the ASPT training, the students advanced to the flightline for T-37 instruction. Transfer-of-training evaluation data were collected by the student's IP on the second and fifth T-37 missions. All IPs had received thorough pretraining in the ASPT on the data collection procedures. The data protocol called for at least one repetition of each of the three tasks on each flight. The IP was to record specific aircraft system states of various task segments as well as provide overall task proficiency grades. The findings of the study are as follows. (a) There were no overall differences between the Day and Night groups in their simulator performance, although there was a transitory superiority of the Day group on control of glidepath descent angle. (b) There were no differences between the Day and Night groups in their performance in the aircraft. (c) The two experimental groups performed reliably better than the Control group on the Takeoff task. The results of this study, when integrated with the findings of other relevant research, indicate that while positive transfer of training to daylight flight can be expected with the use of either a day or night computer-generated display, simulator training should be more extensive than used in the present study and followup data on student performance should be collected. A more extensive transfer-of-training study should be conducted within the context of the Undergraduate Pilot Training T-37 training program, comparing a night scene with the TV model board system currently in use on the Instrument Flight Simulator. (34 pages)

56 **Fuller, J.H., Waag, W.L., & Martin, E.L. Advanced simulator for pilot training: Design of automated performance measurement system. AFHRL-TR-79-57, AD-A088 855. Williams AFB, AZ: Operations Training Division, August 1980. Project 1123. NTIS.** The objective of this effort was to design and implement an automated performance measurement (APM) system in the Advanced Simulator for Pilot Training (ASPT). This report documents that development effort and describes the current status of the measurement system. It was assumed that superior flying performance in the aircraft or the simulator has several characteristics which are reflected by available flight parameters. These include (a) maintaining certain aircraft state parameters, such as airspeed or altitude, close to some defined criterion value, (b) avoiding excessive rates and acceleration forces so that the maneuver is executed smoothly, (c) accomplishing these objectives with the least amount of effort; that is, by minimizing control inputs, and (d) not exceeding procedural or safety limits established for the maneuver. To date, the following scenarios have been implemented on the ASPT: (a) Transition Tasks — Straight and Level, Airspeed Changes, Turns, Climbs/Descents; (b) Takeoff/Approach/Landing Tasks — Takeoffs, Tech Order Climbs, Slow Flight, Configuration Changes, Straight-in Approaches, Overhead Patterns, Touch-and-Go's; (c) Instrument Tasks — Rate Climbs/Descents, Vertical S-A, Vertical S-D, GCA, Proceed Direct to VOR; (d) Aerobatics — Aileron Rolls, Barrel Roll, Loop, Split S, Cloverleaf, Cuban 8, Lazy 8; and (e) Formation — Fingertip. This measurement capability has been subsequently utilized in numerous training research studies. The generalizability of the measurement approach has been

demonstrated in recent modifications of many of the scenarios for use by the ASPT in an A-10 aircraft configuration. Such generality points to the possibility of developing standardized measurement scenarios applicable to a wide variety of aircraft and simulator types. (70 pages)

57 **Albert, W.G. Predicting involuntary separation of enlisted personnel. AFHRL-TR-79-58, AD-A082 995. Brooks AFB, TX: Computational Sciences Division, January 1980. Project 6323. NTIS.** This report contains the results of a study to compare the classification accuracy of the Motivational Attrition Prediction (MAP) method to the classification accuracy of other statistical algorithms capable of predicting involuntary separation within the Air Force enlisted force. The MAP computer program, which was implemented on the UNIVAC 1108 computer system at the Air Force Human Resources Laboratory, was modified to increase its data-handling and computational capabilities and was thoroughly tested. This report includes a description of the computerized statistical algorithms, subsample selection from the first-term airman population, independent and dependent variables, model formulation and analysis, comparison of required computer resources, and related research efforts. (36 pages)

58 **Ausburn, F.B., Ausburn, L.J., & Ragan, T.J. Task analysis schema based on cognitive style and supplantational instructional design with application to an Air Force training course. AFHRL-TR-79-59, AD-A082 342. Lowry AFB, CO: Technical Training Division, February 1980. Project 2313, Contract F33615-77-C-0047, University of Oklahoma. NTIS.** The primary goal of this study was to develop a schema for learning task analysis and the design of instruction in which the cognitive style of learners is a major contributing variable. By identifying the functions a task requires, it can be determined which cognitive styles are likely to be incompatible with the task. Instruction can then be designed which provides necessary assistance through supplantation, which is defined as either altering the task requirement to better suit the capabilities of the learner of performing the function for learners which they are unable to perform for themselves. A task analysis schema was produced which identified (a) classes or types of learning tasks related to cognitive style, (b) specific cognitive styles related to each class of task, and (c) instructional techniques recommended for each class of task in order to deal with cognitive style problems. The schema was applied to the tasks specified in the objectives of an Air Force training course. The Weapons Mechanic Course was analyzed using the proposed schema to demonstrate that it was particularly workable and was also well founded theoretically. The schema was found to be relevant to many of the course objectives and to generate recommendations for effective instruction. (70 pages)

59 **Engler, H.F., Davenport, E.L., Green, J., & Sears, W.E., III. Human operator control strategy model. AFHRL-TR-79-60, AD-A084 695. Wright-Patterson AFB, OH: Advanced Systems Division, April 1980. Project 2313, Contract F33615-77-C-0042, Georgia Institute of Technology. NTIS.** Present measures of performance during training are inadequate for sensitively describing cue utilization, for assessing individual differences, and for predicting transfer of training to other tasks. The present research attempted to approach this problem by developing a computer simulation of continuous motor control learning, including a representation of control strategy, and applying the simulation to measurement of human control strategy. Initial demonstration and validation tests indicate that the simulation is able to identify aspects of human control strategy, and that such identification may provide a more sensitive measure of performance. (140 pages)

60 **Davis, J.D., Carson, S.B., & Reed, W.R. Feasibility of computer applications to mission-oriented training in the aircraft armament systems specialist career field. AFHRL-TR-79-61, AD-A081 446. Lowry AFB, CO: Technical Training Division, January 1980. Project 1121, Contract F33615-78-C-0052, John Davis Associates. NTIS.** A survey was conducted of base-level, mission-oriented training of Aircraft Armament Systems Specialists (AFSC 46230) upgrading to the 5-skill level at 3 Tactical Air Command bases. Functions performed by Air Force personnel in support of such training were analyzed, as was the training itself, to determine the feasibility of applying state-of-the-art computer technology to the problems of management and administration of the training. Five computer-supportable functions were identified and rank-ordered by the degree to which they could, if automated, provide increases in training effectiveness and efficiency. Several specific problems related to OJT and the upgrade training process in the aircraft maintenance production environment were also identified. Recommendations were made in the areas of computer support of base-level training, development of task-related instructional materials, and standardization of training and training requirements. (136 pages)

61 **Kleinwaks, J.M. Advanced Low Cost G-Cuing System (ALCOGS). AFHRL-TR-79-62, AD-A079 809. Wright-Patterson AFB, OH: Advanced Systems Division, January 1980. Project 1958, Contract F33615-76-C-0060, Singer Company. NTIS.** The G-seat is a device that replicates in a flight simulator the pilot/seat interaction due to aircraft acceleration. The G-suit and seat shaker systems provide important cues to the pilot used in the control of the aircraft. These cues are believed to be particularly significant in high performance tactical aircraft. In order to investigate G-cuing philosophies and drive schemes, a system was developed with capabilities exceeding that of present G-cuing systems, which will allow the determination of how to obtain the maximum benefit from these cuing sources. The Advanced Low Cost G-Cuing System (ALCOGS) embodies the basic somatic capabilities of the first generation G-seat coupled with high response speed and system flexibility. ALCOGS combines G-seat, G-suit, and seat shaker systems into one integrated G-cuing system. (76 pages)

62 **Bailey, J., Hughes, R.G., & Jones, W.E. Application of backward chaining to air-to-surface weapons delivery training. AFHRL-TR-79-63, AD-A085 610. Williams AFB, AZ: Flying Training Division, April 1980. Project 1123. NTIS.** Experienced pilots acquired a 30-degree dive bombing task in the Advanced Simulator for Pilot Training (ASPT). Half the subjects acquired the task under a "whole task" approach; half under a "backward chaining" approach. Criterion performance was defined in terms of circular bomb error. The results indicated that subjects in the backward chaining group performed significantly better than subjects in the whole task group when training time for the two groups was equated. The results demonstrate that backward chaining may be used to significantly enhance the effectiveness of simulator-based instruction on a sequential task such as manual dive bombing. The results provide an important demonstration of the appropriateness of basic learning theory principles and techniques for generating effective instructional approaches utilizing the unique capabilities of the flight simulator. (26 pages)

63 **Goclowski, J.C., & Baran, H.A. Digital Avionics Information System (DAIS): Life Cycle Cost Impact Modeling System (LCCIM) — A managerial overview. AFHRL-TR-79-64, AD-A093 281. Wright-Patterson AFB, OH: Logistics and Technical Training Division, November 1980. Project 2051, Contract F33615-75-C-5218, Dynamics Research Corporation. NTIS.** This report provides an overview of the Life Cycle Cost Impact Modeling System (LCCIM). The LCCIM can be used to assess the impact of weapon system characteristics on system support resource requirements and life cycle cost (LCC). It was developed to enhance present Air Force capability to conduct trade-offs between competing design, manpower, and logistics alternatives early in the weapon systems acquisition proces

This report also contains a general description of the initial application of the LCCIM: an analysis of the potential impacts of the Digital Avionics Information System (DAIS) concept of avionics integration on LCC and system support personnel requirements. References are provided for other related reports which: describe that application, document the development of LCCIM components, and provide user's guide information and computer program listings.

The basic application of the LCCIM modeling system involves four steps: (1) perform a Functional Analysis to identify existent operational equipment which can functionally satisfy system requirements and establish a reference list of comparable equipment in the DoD inventory for which data is available; (2) perform a Maintenance Analysis to determine how reference values for resource utilization parameters should be modified to reflect design, manpower, and logistics concept changes; (3) exercise the Training Requirements Analysis Model (TRAMOD) component of the LCCIM to determine a baseline training program based on skill and knowledge requirements; and (4) exercise the Reliability and Maintainability and Cost Model (RMCM) component of the LCCIM to aggregate resource utilization and then compute total life cycle cost estimates for use in the comparison of trade-off alternatives.

The LCCIM is a powerful tool for determining system support resource requirements as well as conducting LCC trade-off analyses. It is user-interactive and extremely versatile; operable on input data at varying levels of detail during all phases of the weapon system acquisition process. Responsiveness to both general and detailed queries encourages more trade-off analyses to be conducted early in the design process, where cost avoidance information can be most effectively acted upon. LCCIM data processing takes into account the interaction between support requirements and cost parameters. Its outputs provide increased visibility concerning both individual and collective impacts, thus affording information concerning the "why" as well as the "what" of trade-off analysis results. In addition, the LCCIM is operable at the system, subsystem, and line-replaceable-unit (LRU) level of equipment indenture. As such, it is useful in the evaluation of discrete impacts and in the identification of "high drivers" of system support resource requirements. (40 pages)

64 **Goclowski, J.C., Glasier, J.M., Kistler, R.H., Bristol, M.A., & Baran, H.A. Digital Avionics Information System (DAIS): Life cycle cost impact modeling system Reliability, Maintainability, and Cost Model (RMCM) — Description users guide. AFHRL-TR-79-65, AD-A089 045. Wright-Patterson AFB, OH: Logistics and Technical Training Division, August 1980. Project 2051, Contract F33615-75-C-5218, Dynamics Research Corporation. NTIS.** This technical report provides guidance to the users of the Reliability, Maintainability, and Cost Model (RMCM). This report contains all information needed for users to interact with the RMCM computer program from a computer terminal.

The RMCM and the Training Requirements Analysis Model (TRAMOD) described in AFHRL-TR-78-58(II) are the two computer programs that are part of the Life Cycle Cost Impact Model (LCCIM) modeling system. The LCCIM can be used to assess the impact of weapon system characteristics on human resource requirements and life cycle cost. It was developed to provide the Air Force with a better in-house capability to conduct trade-offs between competing design, manpower, and logistics alternatives. The initial application of LCCIM was directed at determining potential impacts of the Digital Avionics Information System (DAIS) concept on system support personnel requirements and life cycle cost. The modeling system is, however, applicable in the development of any new weapon system or the modification of an existing weapon system. (See AFHRL-TR-79-64 for a description of LCCIM.)

The RMCM serves as a powerful tool within the LCCIM for conducting resource requirements, costing, and trade-off analyses. User-oriented, it accepts input data at varying levels of detail during all phases of the weapon system acquisition process. Also, the speed of the interactive RMCM computer program will encourage more trade-off analyses early in the design process, where cost avoidance actions are most effective. The RMCM data processing takes into account the interaction between support requirements and cost parameters. Outputs provide for the increased visibility of cost drivers and their individual and combined impacts on system ownership.

Included in this Users Guide are (a) a description of the RMCM functions and capabilities, (b) a description of each cost element which it covers, along with its associated equations, (c) instructions for preparing input data files, (d) a description of the input data format for the cost model data bank, (e) an explanation of the interactive procedures to be used on the computer terminal, and (f) examples of the RMCM batch mode printed outputs. (170 pages)

65 **Goclowski, J.C., LoFaso, A.J., Peskoe, S.E., & Baran, H.A. Air Force personnel availability analysis: A description of the Personnel Availability Model (PAM). AFHRL-TR-79-66, AD-A089 707. Wright-Patterson AFB, OH: Logistics and Technical Training Division, September 1980. Project 1959, Contract F33615-77-C-0032, Dynamics Research Corporation. NTIS.** This is the first of three technical reports describing a methodology for projecting the future availability of Air Force personnel and analyzing the potential impacts of personnel policy changes. Developed within the Air Force Human Resources Laboratory's Project 1959, "Advanced System for the Human Resources Support of Weapon System Development," the methodology will provide the Air Force with an increased capability for considering the human resources requirements of weapon systems in terms of the future availability of personnel needed to maintain and operate the systems, and the factors which determine personnel availability.

The report documents the development of a key element of that methodology—a computerized Personnel Availability Model (PAM) and its associated data bank. Report AFHRL-TR-79-67 describes application techniques, and report AFHRL-TR-79-68 provides a program description which includes an applied PAM analysis of Air Force personnel.

The PAM represents career transition activity within the Air Force by a series of Markov processes, each depicting a subpopulation of airmen with states defined by year of service and paygrade. State transition probabilities are calculated on the basis of actual transition activity data contained in the Uniform Airman Record (UAR). Subpopulations may be defined on an a priori basis such as by Air Force Specialty Code (AFSC) designation, or analytically established by applying a discrete dependent variable regression analysis technique called Logit Analysis. This technique, described in technical report AFHRL-TR-79-67, identifies subpopulations of personnel with similar career transition behavior and describes them in terms of individual attribute data contained in the UAR.

Basically, the PAM operates on UAR data to project future career transition activity on the basis of occurrences in the past. The results are processed to yield "snapshot" descriptions of the total force composition at user selected intervals. The PAM data bank presently contains a selection of data elements from the 1975 and 1976 UAR files for approximately 95,000 airmen assigned to 13 AFSCs. (56 pages)

66 **Goclowski, J.C., Peskoe, S.E., LoFaso, A.J., & Baran, H.A. Air Force personnel availability analysis: Application techniques of the Personnel Availability Model (PAM). AFHRL-TR-79-67, AD-A088 801. Wright-Patterson AFB, OH: Logistics and Technical Training Division, August 1980. Project 1959, Contract F33615-77-C-0032, Dynamics Research Corporation.**

NTIS. This is the second of three technical reports describing a methodology for projecting the future availability of Air Force personnel and analyzing the potential impacts of personnel policy changes. Developed within the Air Force Human Resources Laboratory's Project 1959, "Advanced System for the Human Resources Support of Weapon System Development," the methodology will provide the Air Force with an increased capability for considering the human resources requirements of weapon systems in terms of the future availability of personnel for maintaining and operating the systems and the factors which determine their availability.

Technical report AFHRL-TR-79-66 documents the development of the methodology for a computerized Personnel Availability Model (PAM) and its associated data bank. This report (AFHRL-TR-79-67) describes application techniques of the PAM. Technical report AFHRL-TR-79-68 provides a program description which includes an applied PAM analysis of Air Force personnel.

The PAM represents career transition activity within the Air Force according to a series of Markov processes. Each process depicts a subpopulation of airmen with states defined by year of service (YOS) and paygrade. The PAM uses a mathematical Markov model to project future personnel availability. It assumes that, in respect to career transition, the population of technical personnel is homogeneous within the Air Force. This report describes the results of the effort undertaken to check the validity of the Markov model approach to Air Force personnel availability analysis and also that of the homogeneity assumption.

Two procedures were developed as part of this effort. The first involves the identification of personnel attributes which may impact career transition rates of the Air Force technical personnel. The second procedure involves accurate projections of the described Air Force technical personnel subpopulations if impacting personnel attributes are identified.

No impacting attributes were found for the 13 technical Air Force Specialty Codes investigated. Thus, the validity of the Markov model and the homogeneity of technical personnel are accepted with regard to career transition. In addition, two byproducts of this validation effort tend to widen the range of PAM application. The first byproduct indicated that the procedures developed in this effort also may be applied to nontechnical Air Force personnel. Thus, the PAM also may be used to project the future availability of all Air Force personnel. The second byproduct stems from the statistical techniques used in this effort. It indicated that one of the statistical techniques is useful for modifying transition probabilities based on expected or proposed changes in Air Force personnel policy. (54 pages)

67 **Goclowski, J.C., LoFaso, A.J., Peskoe, S.E., & Baran, H.A. Air Force personnel availability analysis: Program description for the Personnel Availability Model (PAM). AFHRL-TR-79-68, AD-A088 800. Wright-Patterson AFB, OH: Logistics and Technical Training Division, August 1980. Project 1959, Contract F33615-77-C-0032, Dynamics Research Corporation. NTIS.** This is the third of three technical reports describing a methodology for projecting the future availability of Air Force personnel and analyzing the potential impacts of personnel policy changes. Developed within the Air Force Human Resources Laboratory Project 1959, "Advanced System for the Human Resources Support of Weapon System Development," the methodology will provide the Air Force with an increased capability for considering and determining the human resources requirements of weapon systems in terms of the future availability of personnel.

Technical report AFHRL-TR-79-66 described the development of that methodology which includes a computerized Personnel Availability Model (PAM) and its associated data bank. Report AFHRL-TR-79-67 described application techniques to improve the accuracy of the PAM. This report (AFHRL-TR-79-68) provides a description of the computerized PAM programs including an applied PAM analysis of Air Force personnel. (52 pages)

68 **Headquarters Air Force Human Resources Laboratory. Fiscal Year 1981— Air Force technical objective document. AFHRL-TR-79-69, AD-A080 628. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, March 1980. (Covers all AFHRL projects.) NTIS.** This document provides the academic and industrial R&D community with a summary of the technical area objectives of Air Force research in the field of human resources. The areas covered are: (a) Personnel and Manpower Management, (b) Education and Training, (c) Personnel Selection and Retention, (d) Force Structure and Utilization, (e) Flying Training Technology, (f) Technical Training Technology, (g) Simulation Technology for Training, and (h) Personnel and Training Factors in Advanced Systems. (20 pages)

69 **Ree, M.J., & Jensen, H.E. Item characteristic curve parameters: Effects of sample size on linear equating. AFHRL-TR-79-70, AD-A082 341. Brooks AFB, TX: Personnel Research Division, February 1980. Project 7719. NTIS.** In order to establish large item pools, it is necessary to try out hundreds of items for possible inclusion. Because it is impractical to administer several hundred items to several thousand people, the invariance properties of Item Characteristic Curve (ICC) parameters are used to advantage to equate test items. A simulation study was conducted in order to investigate the effects of errors in estimated ICC parameters on equated parameters. Four samples of simulated examinees, ranging from 250 to 2,000 subjects, were administered a different test containing the 20 anchor items, plus 60 additional items on the same scale. The effectiveness of the equating procedures was studied through analysis of summed absolute deviations from the known item parameters of the estimated item parameters and the equated item parameters for the various combinations of "anchor" item calibration sample size and equating same size. (16 pages)

70 **Donahue, K.E., Medellin, A., & Loup, K. Bibliography: Occupation and Manpower Research Division, Air Force Human Resources Laboratory (1957—1979). AFHRL-TR-79-71, AD-A081 751. Brooks AFB, TX: Occupation and Manpower Research Division, December 1979. Project 7734. NTIS.** This report presents a bibliography of technical reports and other publications on the research conducted by the Occupation and Manpower Research Division, Air Force Human Resources Laboratory over the period July 1957 to July 1979. The technical reports listed in this bibliography are obtainable by qualified requestors from the Defense Technical Information Center. (48 pages)

71 **Waag, W.L. Training effectiveness of visual and motion simulation. AFHRL-TR-79-72, AD-A094 530. Williams AFB, AZ: Operations Training Division, January 1981. Project 1123. NTIS.** A review of the literature concerning the training effectiveness of visual and motion simulation is presented in this report. Although there exist much pilot opinion and in-simulator performance data, their extrapolation to training effectiveness information is questioned. The present review focuses on data obtained through the application of the transfer-of-training methodology. The results are discussed in terms of study design factors, and recommendations are made wherein additional research data are needed. (30 pages)

72 **Finstuen, K., & Edwards, J.O. Jr. Longitudinal effects of job change upon interest, utilization and satisfaction attitudes. AFHRL-TR-79-73, AD-A091 753. Brooks AFB, TX: Manpower and Personnel Division, October 1980. Project 7734. NTIS.** This research was designed to identify and assess the effects of a job's context and naturally occurring job content changes upon the job attitudes of 709 Air Force radio operators (career field 293X3). This investigation consisted of two phases. The first phase concentrated upon identifying specific job types within the radio operator career field at two points in time, and determining the flow of personnel from one job type to another over a 17-month period. Eight specific job types along with associated task and job changes are discussed. In the second phase, a series of multiple linear regression analyses were employed in the prediction of job attitude criteria consisting of perceived job interest, felt utilization of talents and training, and overall satisfaction. Results indicated that individual inputs such as months on the job (MOJ) and total active Federal military service time contributed significantly in predicting job interest and felt utilization; and MOJ, aptitude and grade contributed to the prediction of overall job satisfaction. In addition, situational inputs such as number of tasks performed and average task difficulty measures substantially improved prediction of attitudes. Prediction of satisfaction criteria by job types identified in phase one of this study revealed that interest and overall satisfaction tended to be more highly associated with an individual's current job while felt utilization tended to be associated with both the individual's current and past job experiences. The test of a final model incorporating individual and situational inputs as well as job type or group membership information revealed that even when controlling for radio operator and task characteristics, group data in the form of job types contributed significantly to all satisfaction attitude measures. Implications for job satisfaction predictions include improving job perceptions through personnel, task, and duty assignment policies as an approach to job enrichment. (108 pages)

73 **Lewis, W.E., Lovelace, D.E., Mahany, R.W., & Judd, W.A. Computer-assisted instruction in the context of the advanced instructional system: Materials development procedures and system evaluation. AFHRL-TR-79-74, AD-A082 996. Lowry AFB, CO: Technical Training Division, March 1980. Project ILIR, Contract F33615-78-C-0023, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** This report details the second of a two part project to design, develop, implement, and evaluate an authoring system which would provide a basis for the cost effective production of computer-assisted instruction (CAI) materials. It addresses the definition of a procedural model for CAI development, development of a CAI Authoring Procedures Handbook, and evaluation of the complete authoring system. The procedural model consists of six major components: selection of target content, development of CAI materials, formative evaluation, definition and evaluation of student assignment rules, summative evaluation, and on-going evaluation. The Authoring Procedures Handbook describes the authoring procedures model and provides detailed instruction on use of the software tools. Evaluation of the system documents a substantial reduction in materials development time over that of conventional approaches. Additionally, the materials developed reduced average: lesson and objective failure rates, first attempt study time, lesson and objective failure rates, first attempt study time, lesson time to criterion, end-of-block objective failure rates, and end-of-block test objective failure rates as compared to non-CAI approaches. (82 pages)

74 **Deignan, G.M., Seager, B.R., Kimball, M., & Horowitz, N.S. Computer-assisted, programmed text, and lecture modes of instruction in three medical training courses: Comparative evaluation. AFHRL-TR-79-76, AD-A085 609. Lowry AFB, CO: Technical Training Division, June 1980. Project 1121. NTIS.** The present study of 700 medical trainees in three different career fields was conducted to reduce the data gap in medical training on the following major questions: (a) Do computer-assisted instruction, programmed text, and lecture differ in

instructional effectiveness? (b) Do Learners who differ in characteristics (e.g., aptitude and motivation) achieve more in less time under computer-assisted instruction, programmed text, or lecture? Computer-assisted instruction was demonstrated to be more effective in less time than programmed text or lecture; however, aptitude, course, and learner characteristics interacted with achievement and time criteria. Learner characteristics profiles of high-fast and low-slow achievers in each condition were provided to facilitate decisions about alternative instructional assignments. (34 pages)

75 **Nix, C.J., Tate, T., Dutka, S.C., Montgomery, H.L., Showers, D.P., Klem, T.G., & Marshall, A.P. Low-cost technical alternative for learning center managers. AFHRL-TR-79-77, AD-A082 343. Lowry AFB, CO: Technical Training Division, February 1980. Project 1121, Contract F33615-78-C-0037, McDonnell Douglas Astronautics Company—St. Louis. NTIS.** This study established the feasibility of replacing high performance and relatively expensive terminals with less expensive ones adequate for supporting specific tasks of Advanced Instructional System (AIS) at Lowry AFB, Colorado. Surveys of user requirements and available devices were conducted and the results used in a system analysis. The results of the analysis formed the basis for determining the detailed hardware requirements and subsequent hardware selection, procurement and installation. Additionally, the software modifications necessary to accommodate the new hardware were made and the resultant total system was evaluated in an operational training environment. (24 pages)

76 **Headquarters Air Force Human Resources Laboratory. 19th annual conference of the Military Testing Association. AFHRL-TR-79-78, AD-A077 347. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, November 1979. Projects 7734 and 7719. NTIS.** The Military Testing Association Conference was held 17–21 October 1977 at the El Tropicano Hotel, San Antonio, Texas. It was hosted by the Air Force Human Resources Laboratory. Independent presentations were made by members of the Department of Defense, United States Coast Guard, and related Defense contractors. The text of each presentation has been included in this report. (1,458 pages)

77 **Sauer, D.W., Deem, R.N., & Askren, W.B. Expert estimate method of generating maintenance and manpower data for proposed Air Force systems: Evaluation. AFHRL-TR-79-79, AD-A082 994. Wright-Patterson AFB, OH: Advanced Systems Division, March 1980. Project 1124, Contract F33615-77-C-0060, Systems Research Laboratories, Incorporated. NTIS.** The objectives of this study were to exercise an expert estimate method of generating maintenance and manpower data for new systems, to determine the accuracy of the estimated data, to evaluate a prototype guide describing the expert estimate method, to collect cost data for implementing the method, and to prepare a users manual for the expert estimate method. Seventy Air Force technicians having one of three ground radar Air Force Specialty Codes participated as expert estimators. These technicians estimated maintenance, manpower, and training requirements for a new operational ground radar system. The estimators had no experience on the radar system and used only an early design phase engineering description of the system as the basis for their estimates. The accuracy of the estimated data was determined by comparing the estimates with the operational data collected on the radar system. Results indicate that technicians can estimate maintenance task time, crew size, skill level, career field/AFSC requirements, and training times with acceptable levels of accuracy. The method also produced derived person-hour estimates. Estimates of support equipment requirements, the distribution of maintenance tasks, and derived person-hours for troubleshooting and specific off-equipment maintenance tasks were not accurately estimated. The prototype users guide recommendations were generally supported in the areas of

engineering description package and questionnaire preparation, qualifications of estimators, and analyses of estimated data. The person-hours cost data indicated that the minimum number of raters should be increased to 25, and that the expert estimate method seems to be an inexpensive and rapid method of obtaining maintenance manpower data. A revised users guide (Technical Report AFHRL-TR-79-80) was prepared on the basis of the study results. (50 pages)

78 **Sauer, D.W., Deem, R.N., & Askren, W.B. Expert estimate method of generating maintenance and manpower data for proposed Air Force systems: Users guide. AFHRL-TR-79-80, AD-A082 992. Wright-Patterson AFB, OH: Advanced Systems Division, March 1980. Project 1124, Contract F33615-77-C-0060, Systems Research Laboratories, Incorporated. NTIS.** The objective of this effort was to revise a prototype users guide for collecting expert estimates of maintenance, manpower, and training data for new or proposed Air Force systems. The revision of the users guide was based on three separate efforts: a review of recent expert estimate studies, an application of the expert estimate method using the prototype users guide, and an independent evaluation of the guide by experienced manpower professionals. A revised users guide was produced. It contains the procedures for using the expert estimate method to collect maintenance, manpower, and training data for new Air Force systems. It also contains examples of engineering description packages and questionnaires as well as cost data associated with the expert estimate method. (26 pages)

79 **Buckland, G.H., Monroe, E.G., & Mehrer, K.I. Flight simulator runway visual textural cues for landing. AFHRL-TR-79-81, AD-A089 434. Williams AFB, AZ: Operations Training Division, August 1980. Project 1123. NTIS.** The effects of seven different runway types were investigated on pilot performance during landings in a T-37 flight simulator. Data were also gathered on 6 of the same 12 pilots during actual T-37 aircraft landings at the Air Force Flight Test Center, at Edwards AFB. The seven simulated runways consisted of one night runway and six day runways with varying amounts of textural information cues on the runway touchdown zone area. The night runway was also tested with and without touchdown zone landing lights (TD-Zone lights), and the day runways were tested with and without the runway overruns. The simulated aircraft average vertical velocity at touchdown decreased systematically from 201 ft/min for the night runway without the TD-Zone lights to 136 ft/min for the day runway with 4-foot texture patterns. The day runways alone, without the overrun, varied from 195 ft/min for the Bare Bones runway to 136 ft/min for the 4-foot texture pattern. Although these average vertical velocities were still much higher than those recorded in the actual aircraft (32 ft/min), the texture patterns did influence the pilot flare and touchdown in a systematic manner. Additional visual cues might have reduced the vertical velocities even more, but the limited edge capacity of the Computer Image Generation (CIG) scene did not permit the study of other visual cues while investigating texture patterns. The presence of the TD-Zone lights in the night scene also reduced the average vertical velocity at touchdown (190 ft/min), but this difference was not statistically significant. The presence of the runway overruns on the daytime runways limited the overall range of touchdown vertical velocities to a smaller range spanning from 176 ft/min for the "Willie" runway to 158 ft/min for the 4-foot textured runway. When the overrun was present, apparently the pilots used the overrun visual cues, the chevron texture patterns and other related cues, in addition to the runway texture patterns in order to perform the flare and touchdown. This resulted in reduced overall touchdown vertical velocities, but apparently the more uniform pilot performance (restricted range) did not involve an optimum use of the 4-foot texture patterns. Several other data parameters also varied across runway types; however, there were no consistent differences related to runway texture patterns. The significant effects with the other data parameters were most often related to differences between the night and the day runway scenes. (50 pages)

80 **Gustafson, D.E., Mehra, R.K., Ledsham, W.H., & Sajan, S. Recursive forecasting system for person-job match. AFHRL-TR-79-83, AD-A090 499. Brooks AFB, TX: Manpower and Personnel Division, September 1980. Project 2077, Contract F33615-78-C-0050, Scientific Systems, Incorporated. NTIS.** The overall objective of this research effort was to investigate the applicability of time series analysis, state space modeling, and forecasting techniques to prediction of Person-Job Match (PJM) time series. This work was undertaken in order to provide more accurate input data for PJM and thereby yield higher payoffs to the Air Force.

The approach taken was based on several new results in time series analysis and forecasting which allow one to automatically determine multivariate state space models empirically from input-output data. The state space approach is an extension of the Box-Jenkins method and gives superior results for multivariate time series. The form of the models is a Kalman filter/predictor. Once a model has been determined, predictions can be made based on this model and past data. Since the underlying dynamics of the time series may change in an unpredictable manner, provision has been made to estimate the parameters of the model recursively. This allows one, for example, to follow the effects of policy changes (fast rate of change of parameters) or more long-term changes which cannot be explicitly modeled.

The technical effort was divided into three major phases:

Phase I: PJM payoff matrix column mean data over a five-year period, beginning in January 1973, were collected and statistically analyzed. A total of 50 categories were selected to span the dimensions of sex, skill score and job area (Administrative, Electronic, General and Mechanical). A frequency analysis showed that various series contained significantly different spectra, with peaks at 6/year, 4/year, and 3/year. The semiannual component is probably tied to the academic year. A correlation analysis showed that most female high skill series move together. Female low skill series also showed the same trend, though not as marked. Male series were, in general, correlated, but were less so than the female series. Male and female series were essentially uncorrelated. A set of state space models was developed for the individual time series. A set of Kalman filter/predictors was then generated, based on the state space models.

Phase II: An adaptive Kalman filter methodology was developed for the PJM data. The adaptive filter was an approximate maximum likelihood estimator for the Kalman filter/predictor parameters. Two adaptation parameters were used: (a) an age weighting parameter to discount old data, and (b) an adaptation time constant to control the rate of change of the parameter estimates. The adaptation parameters were themselves varied recursively to minimize the mean-squared prediction errors. The dynamic coefficients of a linear Kalman filter/predictor were estimated casually from the data, along with the usual Kalman filter state estimates, and shown to give better performance than the non-adaptive (stationary) Kalman filter/predictor.

Phase III: An extended Kalman filter was developed for use on the PJM data. This filter was intended for use in estimating the parameters of the Kalman filter; i.e., the problem studied was that studied in Phase II. The extended filter did not appear as suitable for use on PJM data due to: (a) increased complexity, (b) its generally poor convergence properties, and (c) its generally decreased accuracy. (314 pages)

81 **Dansereau, D.F., Holley, C.D., Collins, K.W., Brooks, L.W., McDonald, B., & Larson, D. Validity of learning strategies/skills training. AFHRL-TR-79-84, AD-A085 659. Lowry AFB, CO: Technical Training Division, April 1980. Project 1121, Contract MDA-903-76-C0218, Texas Christian University. NTIS.** Research has documented that most students tend to employ inefficient or less-than-effective methods for acquiring, retaining, retrieving, or applying information. To acquire, retain, and appropriately apply knowledge, it has become evident that methods designed to organize information for presentation to learners are of beneficial, yet limited, effectiveness. In contrast, strategies which the learner finds useful in transforming information through personal effort are likely to be "owned," retained, and contribute to increased performance. Programmatic research was initiated to (a) identify and compare the effectiveness of alternative learning strategies upon learner performance, (b) incorporate effective strategies and interactive practice materials within a systematic training program, and (c) empirically validate the performance of strategies-trained and untrained students. Some of the strategies included have been (a) various mnemonic devices, (b) imagery elaboration, (c) paraphrasing, (d) visual networking, (e) goal-setting, (f) distraction desensitization, and (g) formal peer interaction.

Strategies-trained students achieved 17% to 40% more on technical subject-matter achievement tests than did untrained students. Low reading aptitude students achieved more under imagery strategies than low reading aptitude controls under the paraphrasing or the untrained strategies condition. Visual networking strategies students scored 26% higher on delayed retention achievement tests than controls in the untrained group. In most cases, high reading aptitude students achieved more than lower reading aptitude students. (66 pages)

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Lowry AFB, Colorado 80230

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Wright-Patterson AFB, Ohio 45433

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